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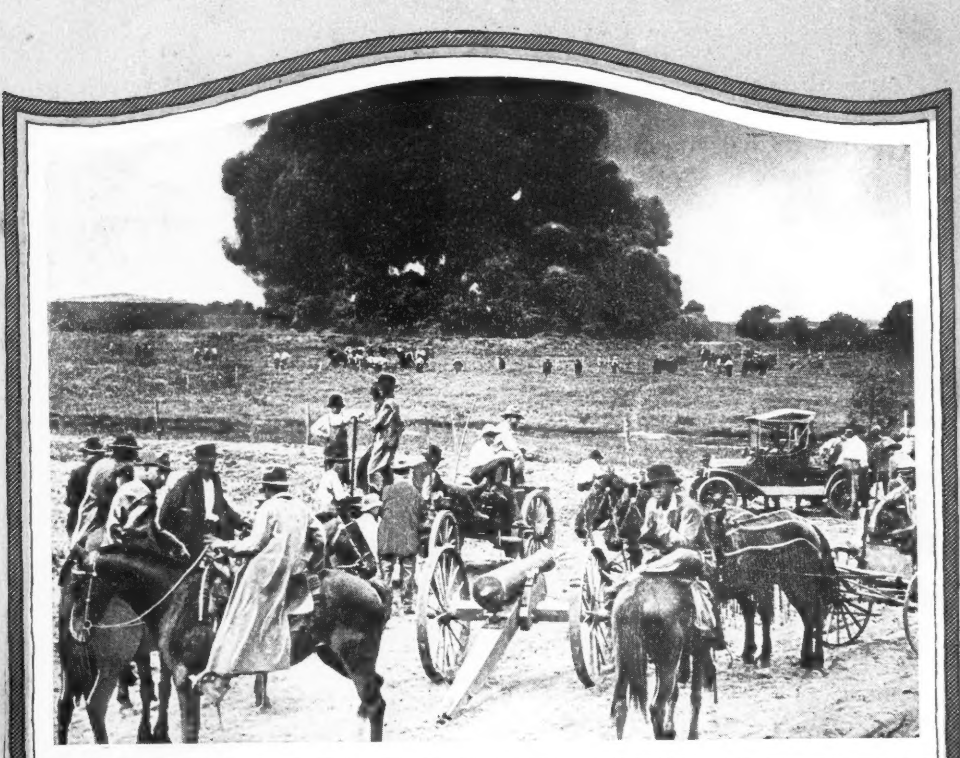

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BIG OIL TANK ABLAZE IN CUSHING FIELD, OKLA. CANNON FIRED PROJECTILES USED TO PUNCTURE TANK BELOW BLAZE LINE LETTING OIL FLOW OUT.

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AUGUST, 1921

A Modern Milk Condensery

Indispensable Services Performed by the Vacuum Pump and the Compressor in Supplying a Fitting Substitute for Fresh Milk

By ROBERT G. SKERRETT

IT IS A far cry from the lowing kine to the pulsing compressor; and the layman may not readily grasp that a link exists between nutrition and the vacuum pump. But we shall see presently that engineering has its contact with the pasture lands and is doing much to amplify our dietary and to give people remote from our browsing herds an abundance of a food peculiarly necessary to the maintenance of a balanced ration.

The scientist is gradually driving home to us that milk can and should play a far bigger part in our bodily economy than is commonly appreciated. A plenty of fresh or so-called "fluid milk" is not within the reach of everyone, not necessarily because of cost but largely by reason of physical circumstances that hamper transportation and refrigeration prior to consumption. Fresh milk is a perishable article. Therefore, the technicist has done his best to provide a fitting substitute, and thanks to his cunning, preserved milks are to-day available that will answer every purpose and which may be distributed far and wide with little fear of spoiling.

How many of us are aware of the extent of the milk condensing industry in this country? And, further, what percentage of us has any knowledge of the care that is exercised in turning out a can of this foodstuff that will be fit for human consumption and which, besides, will remain good for a long while after its preparation? To the uninitiated, a modern milk-condensing plant is a revelation; and a trip through one is bound to create a most favorable impression.

The condensing of milk is by no means a simple undertaking. Judgment and caution must be displayed at every step; and just in proportion to the measure of this supervision the finished commodity will retain its original virtues in storage and anywhere under the sun. In short up-to-date methods of manufacture place condensed milk, in a nutritional sense, on a par with fresh milk. It is both a food and a medicine.

THE VACUUM pump or the air compressor reversed plays the principal role in one of America's industries that turns out annually products to the value of more than $190,000,000.

In the United States there are fully 240 factories engaged in the condensing of milk, and in the course of a twelvemonth they handle quite 4,500,000,000 pounds of the raw commodity.

In reducing the volume 45 per cent. it is necessary to evaporate and condense a tremendous quantity of water without cooking the milk the while. This is effected through the agency of the vacuum pan linked with a condenser and vacuum pump. Very few of the general public are familiar with the methods of operation of this vast business, and yet the subject is one that concerns hundreds of millions of people.

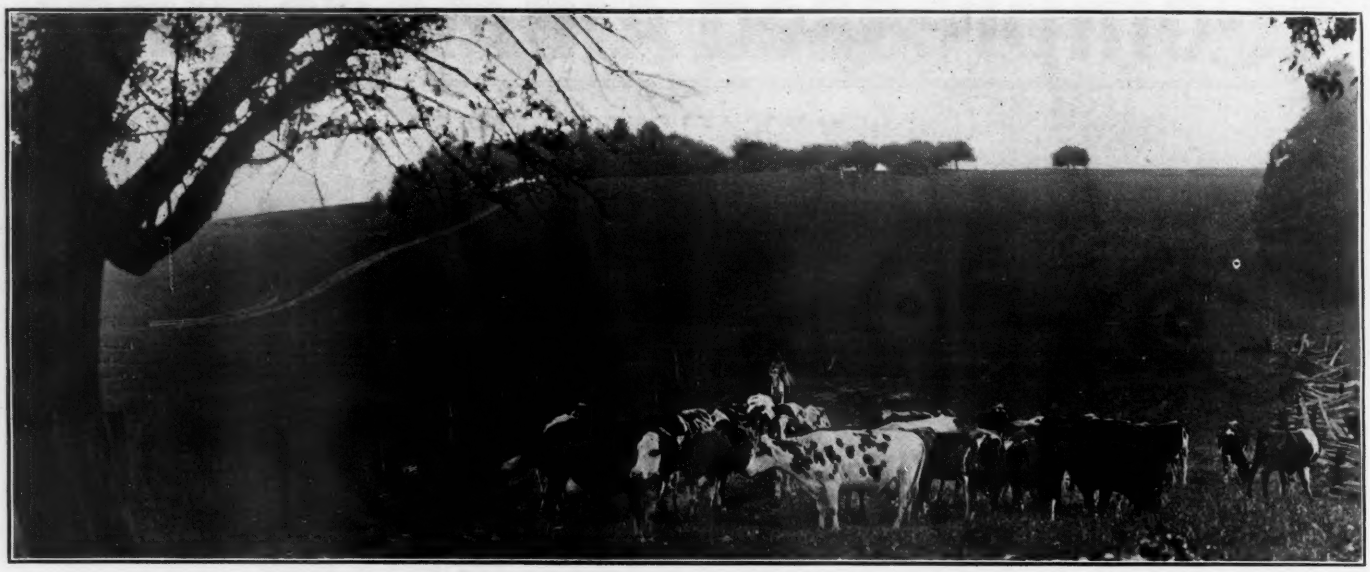
Commercially speaking, the production of condensed milk dates from 1856, when Gail Borden established his first factory for its making at Wolcottville, Connecticut. The industry, then in an experimental stage, has gone through various evolutional processes. The continual adoption of new facilities and up-to-date machinery, as manufacturing requirements increased, has resulted in quantity production of high-grade and thoroughly satisfactory preserved milks.

History has a way of repeating itself. Despite his initial success, there was only a modest demand for Borden's condensed milk up to 1861, but the Civil War gave birth to conditions that at once emphasized the usefulness and the value of the article. Similarly, while the succeeding decades of peace afforded a continually increasing market for milk of this kind, still the years of the World War led to a tremendous expansion of the business.

In 1913, American factories produced substantially 250,000,000 cans of sweetened condensed milk and 390,000,000 of unsweetened or evaporated milk, the cans being of differing weights, and the large size usually of one pound. In 1919, our plants put up 2,031,000,000 pounds of condensed milk, and this represented a total value of about $193,000,000.

Exact figures are not at present available showing the amount of capital invested in the buildings and equipment of this industry today, but ten years ago the structures and their apparatus cost $15,000,000. With the expansion that has taken place since the money involved now cannot be less than $30,000,000—indeed, the sum is probably a good deal more.

Before describing the various activities in a typically modern plant, confusion may be avoided by differentiating between the two forms of canned milk most marketed: sweetened condensed milk and evaporated milk, which is unsweetened. Up to a point both commodities are subjected to the same preparatory treatment, but the omission of sugar from the evaporated milk imposes some additional operations. Let us take the first procedure followed in turning out the older variety, i. e., sweetened condensed milk, and imagine ourselves in the heart of one of New York State's richest agricultural districts.



Driving a herd from pasture to milking barns. This is done usually late in the afternoon after they have grazed all day on the lush grass of the meadows.

The condensery is a substantial looking structure, and at the front and centrally placed is a receiving station which is conveniently linked with the highway. An elevated approach brings, one by one, the laden and waiting motor trucks and horse-drawn vehicles to a level where they can easily discharge their loads of fresh milk carried in the big containers familiar to most of us. In the receiving room are white-clad workers, and cleanliness is manifested in every direction. One expert opens and smells every can; and if the odor betrays the slightest taint the milk is rejected and returned to the producer.

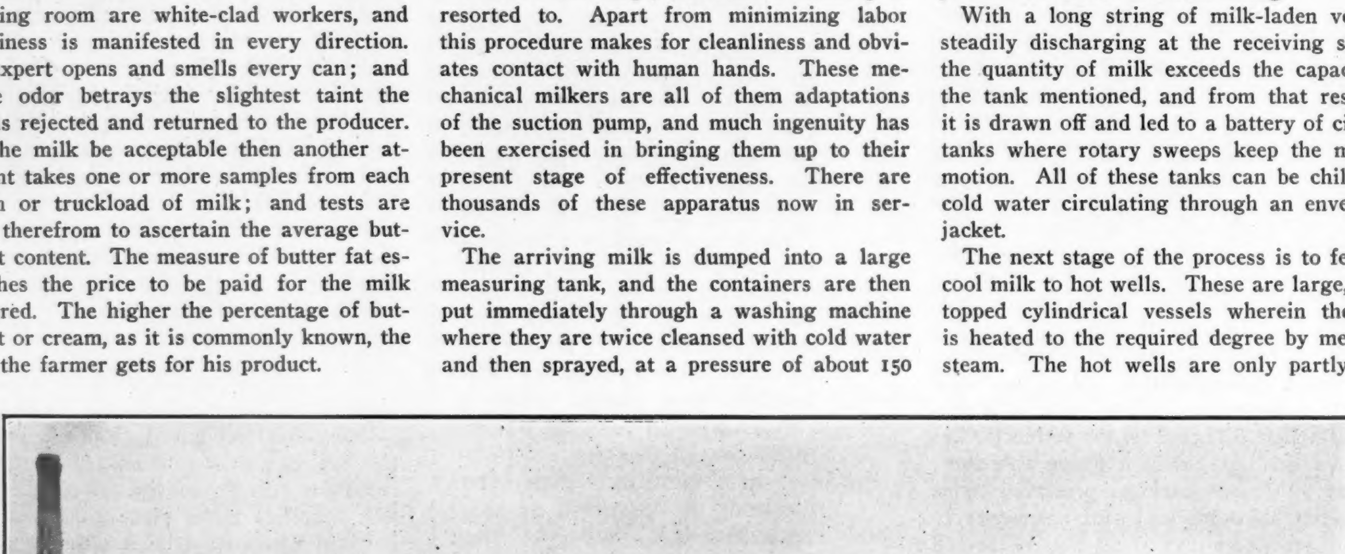
If the milk be acceptable then another attendant takes one or more samples from each wagon or truckload of milk; and tests are made therefrom to ascertain the average butter-fat content. The measure of butter fat establishes the price to be paid for the milk delivered. The higher the percentage of butter fat or cream, as it is commonly known, the more the farmer gets for his product.

Milk is examined in other ways as well. For instance, samples are scrutinized at various intervals for the determination of sediment in the fluid milk received. Every possible safeguard is thrown around the raw milk in order that there may be no doubt of its fitness for human consumption when canned. To this end, in many dairies, especially where the herds are large, mechanical milking is resorted to. Apart from minimizing labor this procedure makes for cleanliness and obviates contact with human hands. These mechanical milkers are all of them adaptations of the suction pump, and much ingenuity has been exercised in bringing them up to their present stage of effectiveness. There are thousands of these apparatus now in service.

The arriving milk is dumped into a large measuring tank, and the containers are then put immediately through a washing machine where they are twice cleansed with cold water and then sprayed, at a pressure of about 150 pounds, a like number of times with hot water, in which soda has been dissolved. The cans issue from this apparatus perfectly sterilized, and dry. After the milk has been weighed, and the producer has been duly credited with the amount received, the fluid is fed to a big rectangular storage tank, where it is stirred continually by power-operated paddles to prevent the butter fat from rising.

With a long string of milk-laden vehicles steadily discharging at the receiving station, the quantity of milk exceeds the capacity of the tank mentioned, and from that reservoir it is drawn off and led to a battery of circular tanks where rotary sweeps keep the milk in motion. All of these tanks can be chilled by cold water circulating through an enveloping jacket.

The next stage of the process is to feed the cool milk to hot wells. These are large, open-topped cylindrical vessels wherein the milk is heated to the required degree by means of steam. The hot wells are only partly filled



Illustrations, Courtesy Borden Condensed Milk Co.

A typical up-to-date milk condensery located in the heart of a dairy country where milk is plentiful and of excellent quality. A plant of this sort represents an outlay of quite a quarter of a million dollars.

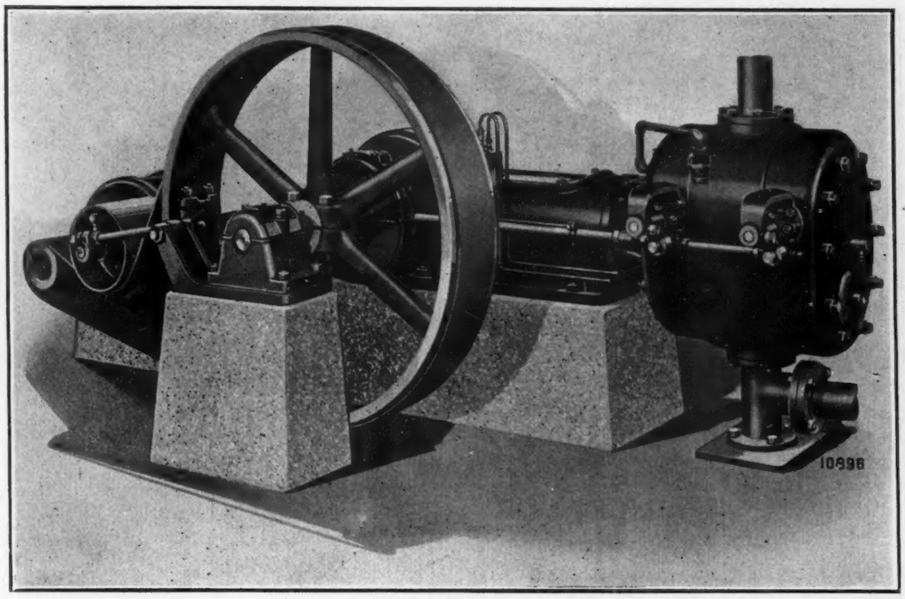
with the raw milk inasmuch as it expands and rises rapidly when sufficiently heated. The operation is halted the moment this upward movement brings the foaming mass level with the top of the well. About 2,000 pounds of milk are dealt with at a single heating. The purpose of this "forewarming" is to destroy most of the bacteria, yeast, molds, etc., that may be present both in the milk and the sugar which is added at this time.

The sugar content is varied from sixteen to nineteen pounds per 100 pounds of raw milk. Now for the actual condensing, the prime work of the plant, which brings into play the big vacuum pans—closed vessels of shining copper. These are the vital organs of the condensery, and every other process or function is tributary to these dominating apparatus. According to the size of the establishment the number of the vacuum pans varies, but in the factory visited there were three of these capacious caldrons.

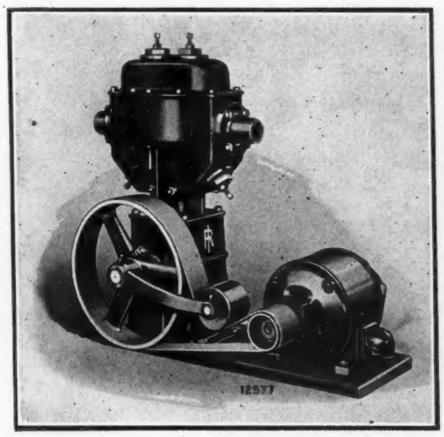
Emphasis is laid upon the part played by the vacuum pans because in no other way would it be feasible to secure the desired results to the satisfaction of the ultimate consumer and commercial requirements; and here we see how the vacuum pump, *per se*, or the compressor reversed figures in one of America's greatest industries. The penumatic engineer stands forth again. Each vacuum pan has a maximum diameter of something like seven feet, and the cylindrical portion is surmounted by a glistening dome. A steam jacket at the bottom of the pan and a series of copper coils within the body or cylindrical section constitute the heating elements.

The coils can be operated separately; and as these are placed at different heights steam is admitted to each only when it is covered by the milk. In the dome is a glazed deadlight through which the rays of an incandescent globe can be projected into the vacuum pan so that the attendant can watch the height of the milk and regulate the use of the several coils accordingly. When the apparatus is in full swing the milk tumbles about violently. The vapor given off by the milk is withdrawn through the action of a powerful vacuum pump, and this steam passes from the top of the dome into a condenser. A vacuum pan of the size in question will handle, in the course of a working day, fully 100,000 pounds of fluid milk. The milk is drawn into the pan continuously, but only in such volume as to offset evaporation. The aim is to keep the top of the milk at a fairly constant level, and at a point a little above the uppermost coil.

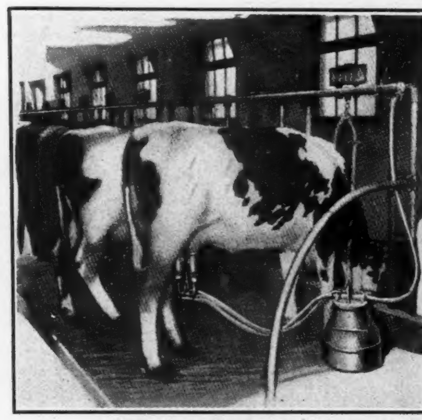
The primary object in boiling the milk in vacuo is to lower the temperature at which vaporizing takes place. Under normal conditions, the boiling point of milk is about 214 degrees Fahrenheit. If actually heated to this extent the milk would acquire a noticeably cooked flavor, which is undesirable, and the commodity would change color and become rather dark. Therefore, the manufacturer seeks to induce evaporation without inviting these objectionable changes, and does this by heating the milk in a partial vacuum. Further, condensing in vacuo is more economical, can



Vacuum pump short-belted to an electric motor.

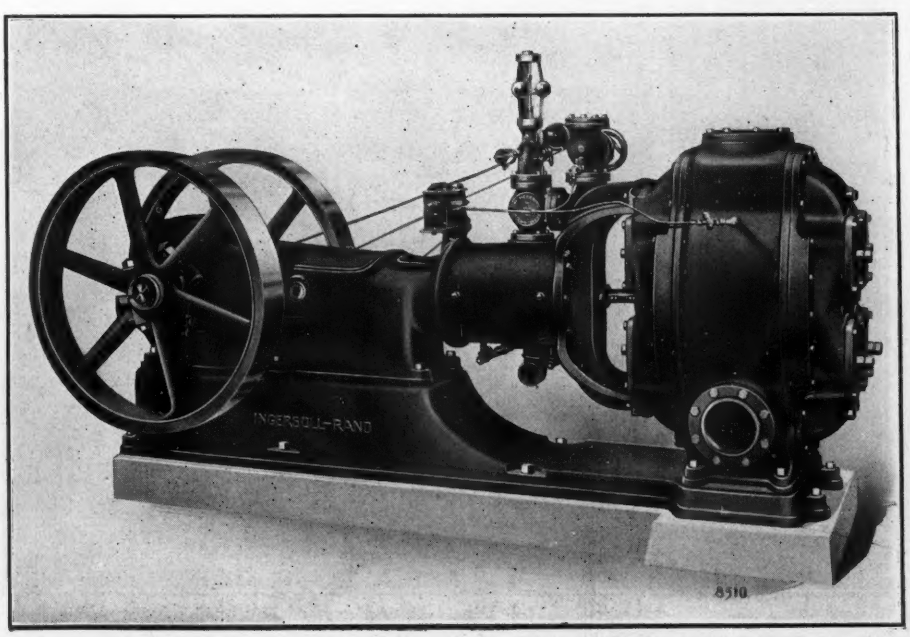


Vacuum pump short-belted to an electric motor.

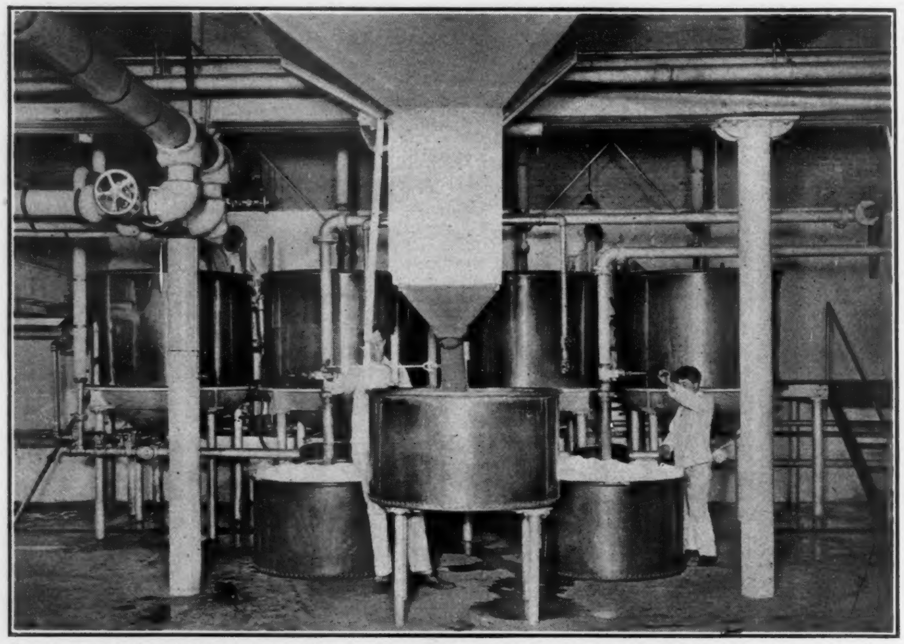


Courtesy, De Laval Separator Co.

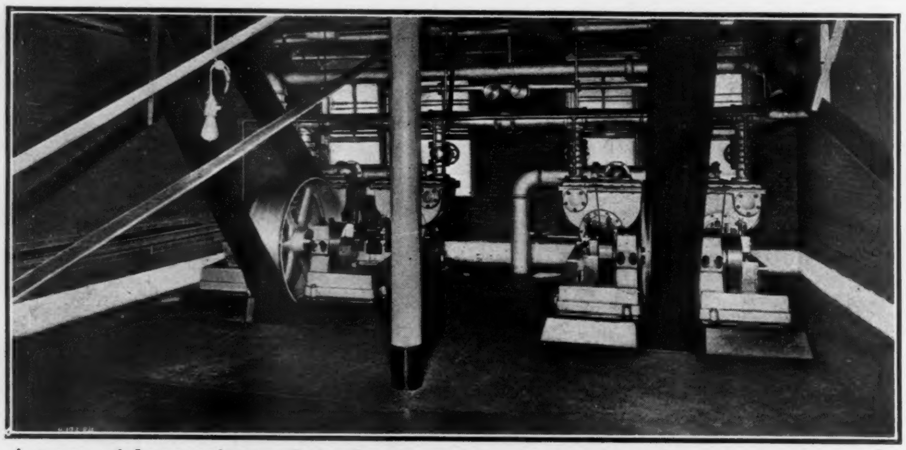
The dairy at the Naval Academy, Gambrills, Md., showing pneumatic device for milking cows.



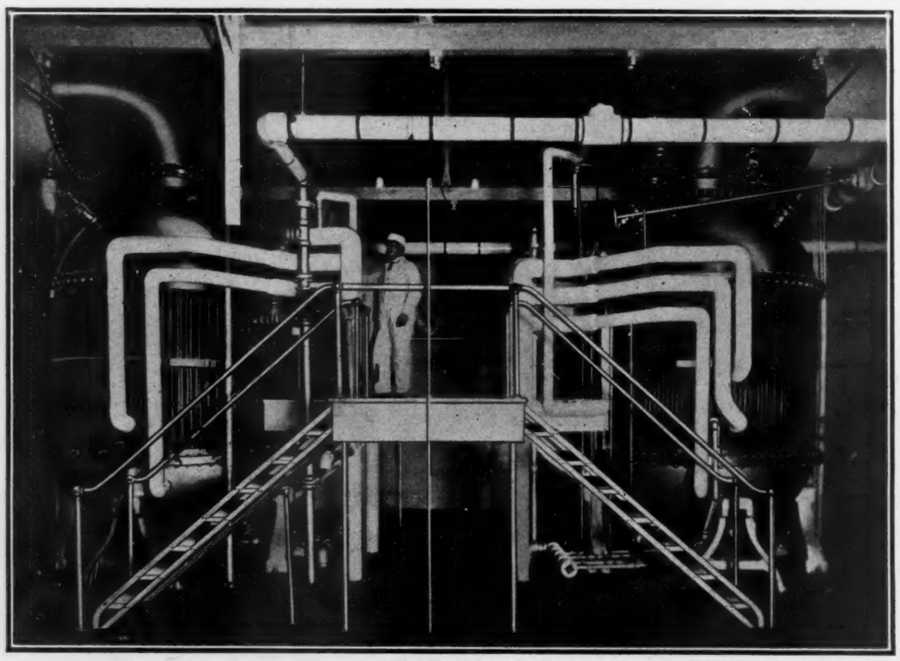
Straight line steam-driven vacuum pump, equipped with piston steam valve.



A group of hot wells, where the fresh milk is forewarmed prior to being fed to the vacuum pans. In the case of sweetened condensed milk the sugar is usually added at this stage of the process.



A group of homogenizers, where the evaporated milk is subjected to high pressure to break up the globules of butter fat and thus to prevent the solids from separating or rising according to their different specific gravities.



Illustrations, Courtesy Borden Condensed Milk Co.

Two big vacuum pans. It is by means of these that the water content of the milk is reduced to the desired degree either in preparing sweetened condensed or evaporated milk.

be accomplished quicker, and for this reason, the effective capacity of the apparatus is increased.

By starting the vacuum pump, and thus promoting the exhaustion of the vacuum pan, a suction is created which causes the milk to flow up into it from the hot wells. As the milk rises and submerges one coil after another inside the pan, the attendant admits steam successively to the jacket and to the various coils. Condensing takes approximately two hours; and the consistency of the milk is tested from time to time by means of hydrometers. It follows logically that a milk rich in fat will yield more of the condensed product than milk low in solids. In round figures, it requires approximately 2¾ gallons of fresh milk to give one gallon of condensed milk.

The vacuum occasioned by the pump ranges from 25 inches to 28 inches in the pan, and the higher the partial vacuum the lower the boiling point. As a matter of interest, water boils at a temperature slightly over 126 degrees Fahrenheit in a vacuum of nearly 25.9 inches, while with a vacuum of 28 inches the water will boil at 100 degrees Fahrenheit.

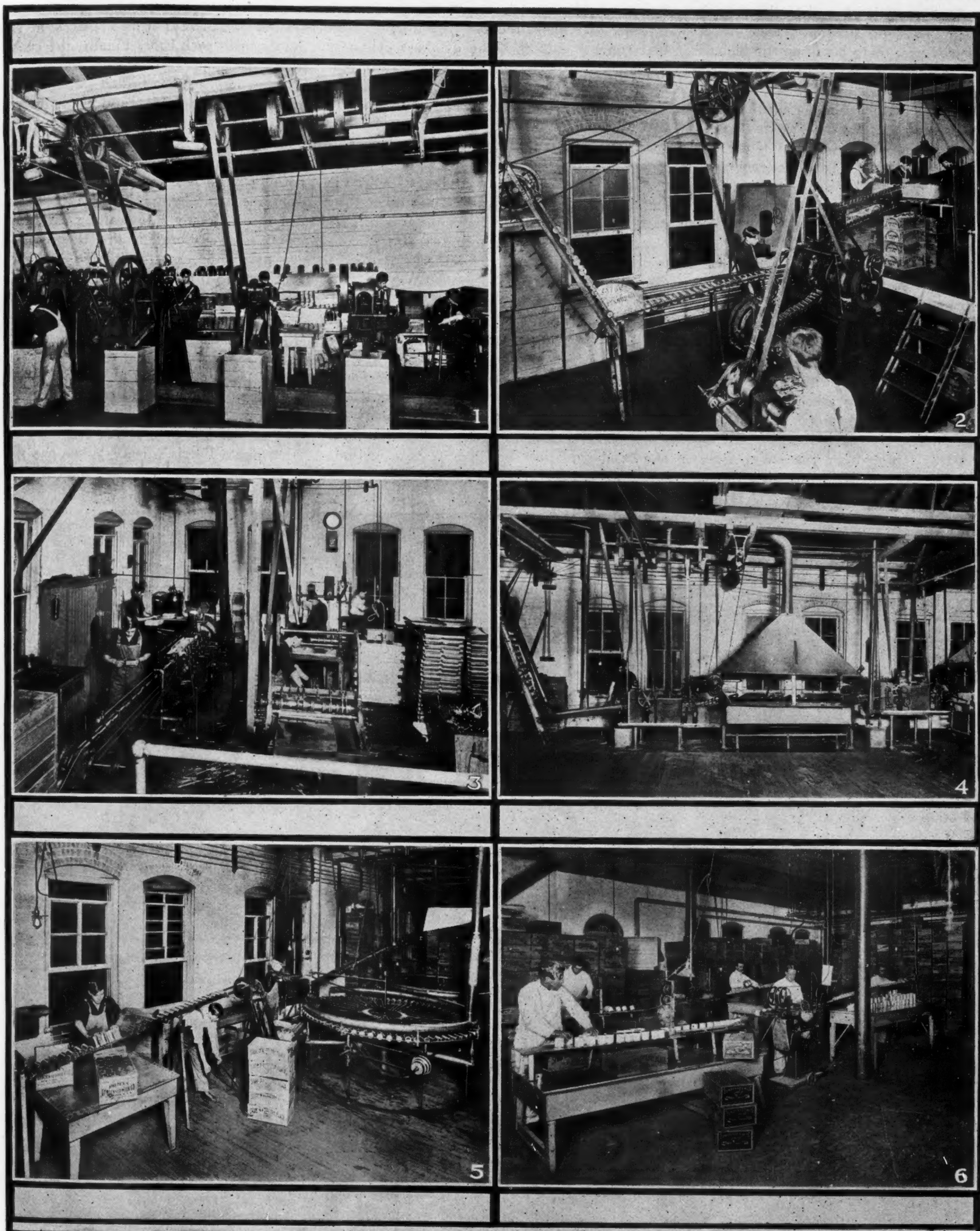
One of the biggest problems in condensing milk of the sweetened kind is to prevent the sugar from crystallizing and thus causing what is known as "sandiness." Success in this direction depends upon a number of things, such as the method employed and the time chosen for adding the sugar, and the temperatures used both in the hot wells and the vacuum pans, not to mention the cooling practices after condensation. Each manufacturer has his own way of dealing with this phase of the subject, and, naturally, keeps his procedure secret. That a satisfactory product is the reward only of much care is exemplified by the fact that a deficiency in sugar is apt to invite a gelatinous milk or one that may spoil. On the other hand, an excess of sugar is certain to produce sandiness.

When the sweetened milk has been sufficiently concentrated it is discharged from the vacuum pans into glass-lined tanks whence it flows through cooling coils, chilled by circulating brine supplied by the refrigerating plant. After being cooled to the desired degree, the milk goes on to other glass-lined tanks, and from them it descends to the can-filling machines.

Now let us go back and take up the story of evaporated milk, which was not successfully manufactured until 1885, and was then undoubtedly the outcome of the experience gained in the production of sweetened condensed milk. The fact that evaporated milk is unsweetened necessitates that it be given certain special treatments that will make it acceptable to the ultimate purchaser and insure its keeping qualities.

In making evaporated milk, the fluid passes through the hot wells and the vacuum pans, just as does the preserved milk, but, of course, no sugar is added in the hot wells. When the milk has reached the desired density in a vacuum pan, the hot and thickened liquid is withdrawn and fed to a machine known to the industry as a homogenizer. This is a six-cylinder apparatus of powerful construction

Phases of Can Making and Packing in the Condensed Milk Industry



Illustrations, Courtesy, Borden Condensed Milk Co.

Fig. 1. The machines that stamp out the tops, bottoms and caps of cans. Suction cups pick up the blanks of tin plate and handle them like so many human fingers. Fig. 2. A heading machine which squeezes the tops and bottoms of the cans into place upon the bodies of the containers prior to their being put through the soldering machine. Fig. 3. To the left is the machine that bends the blanks for the can bodies prior to their soldering, which is also done mechanically. Fig. 4. The finishing stage in the can-making shop. The hot cans, after issuing from the last of the machines, are cooled by an air blast as they travel on the way to the testing apparatus before passing into the filling room. Fig. 5. Before the newly made cans are passed on to the filling department they are subject to a test for tightness. In this case the cans make the circuit of a vacuum testing apparatus, and cans that leak automatically drop into a chute and are discarded. Fig. 6. Placing the cans in boxes ready for shipment.

which pumps the milk and forces it, under a pressure of 3500 pounds, through a series of fine apertures.

From these constricted outlets the milk issues in thin films or streams. This process serves to pulverize or to break up the globules of butter fat so that these very fine particles remain thereafter distributed throughout the milk and do not tend to combine again. Otherwise, the lighter solids would go to the top and the heavier ones to the bottom of the container—a condition that is distasteful to a purchaser.

Leaving the homogenizer, the evaporated milk is carried through water-cooled coils by which the temperature is brought down to 60 degrees Fahrenheit; and the next stage of its journey takes it to the brine cooler, where its temperature drops to 45 degrees Fahrenheit. The brine is chilled by the expansion of liquid ammonia from the ammonia compressor. When thus cooled, the milk is discharged into enamel-lined tanks, from which it flows by gravity to the can-filling machines. One of these fillers will handle 100,000 sixteen-ounce cans a day. The cans are fed into the apparatus in tray lots and are run under a corresponding number of cylinders each of which is designed to hold just enough milk to charge the waiting empty container. They are filled simultaneously, and the operation is controlled by the working of a lever. A plunger in each cylinder determines the exact quantity of milk that can run into it. One of these cylinders has its tubular glass lining exposed so that the attendant can see when it is exhausted. The outlet of that cylinder is slightly smaller than the exhaust nipples of the other cylinders, and, therefore, the milk takes a little longer to escape.

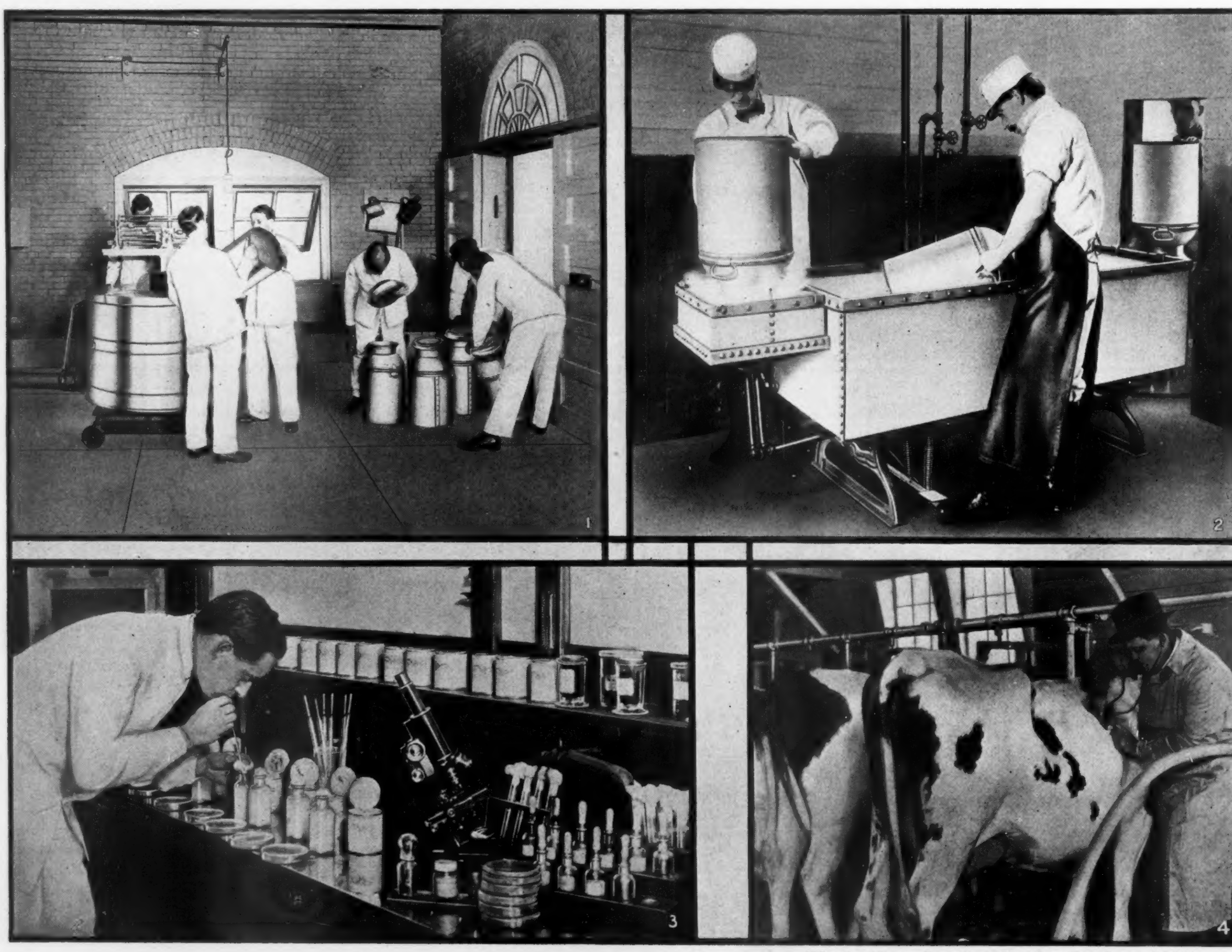
Accordingly, when the index cylinder is empty the watcher knows that the other cans must be filled, and then allows the tray to pass onward to the machines that seal the containers. In this fashion lot after lot of the cans are duly charged.

The sealing operation is effected by three apparatus. One is equipped with a group of small hollow plungers or rods that move vertically and which are connected with a suction pump, and there is a rod or pneumatic finger for every can in the tray. The first action of the plungers, in advance of the arrival of the laden containers, is to descend and pick up a like number of little tin discs or caps. A moment later, when the cans have taken their stations beneath the plungers, the discs are dropped over the filling holes by releasing the vacuum.

The tray then moves a short distance to a second mechanism which places a ring of solder upon each cap. Finally, the cans reach a near-by soldering machine, and at the right moment multiple gas-heated irons are lowered which melt the solder and then, by rotating upon their vertical axes, make sure that every point on the rim of the disc is sealed.

In the case of sweetened condensed milk nothing more is necessary except to label the cans mechanically, pack them in cases, and run them directly into waiting cars for shipment. But evaporated milk, before the labels are pasted on, must undergo a concluding treatment to insure its keeping qualities. That is to say, the cans of evaporated milk are subjected to sterilizing by being exposed for a while to the heat of live steam.

The sterilizers are big cylindrical affairs of steel capable of dealing at one time with 6,720 cans, the contents of 140 cases. The cans are set in metal crates and run into a series of compartments in a revolving framework something like a Ferris wheel. When the sterilizer is thus loaded, its door is closed and the re-



Illustrations, Courtesy Borden Condensed Milk Co.

Fig. 1. The receiving room of a milk condensery, where the arriving foodstuff is carefully inspected and then weighed by an automatic machine. Fig. 2. Cleaning and sterilizing milk cans before returning them to the dairymen. Fig. 3. No matter how carefully manufactured, or how exact the technique employed in that work, the real test of the quality of milk, is after all, in the laboratory. Fig. 4. No milk is allowed to enter the supply sent to a condensery until after each cow has been carefully examined by a competent veterinarian. This insures that no milk is used which is not safe and wholesome for human consumption.

tort is almost filled with hot water. The temperature of this fluid is raised to the desired point and maintained there as long as necessary by the admission of steam. All the while the framework, with its burden of cans of evaporated milk, slowly revolves. The maximum temperature and the duration of exposure to it vary agreeably to the seasonal character of the milk, and the sterilizing is, for that reason, under the supervision of an expert.

It will be noted that from the moment the raw milk is first received and dumped into the weighing tank until it is condensed and packed in the cans it is dealt with mechanically and untouched by the hands of the operatives. Cleanliness prevails on all sides and sanitary precautions are exercised at every step to prevent contamination by microörganisms. This story would not be complete without reference to the can-making department of the condensery, where the tins are turned out at the rate of 180 a minute. The manufacture of the cans is, in the main, a machine proposition, and labor is reduced to a minimum. From the original sheets of tin are stamped and cut the bodies, the bottoms, the tops with their filling holes, and the small caps that seal the cans. Suction cups on the ends of hollow spindles pick up the metal sheets and feed them to the cutters and stampers.

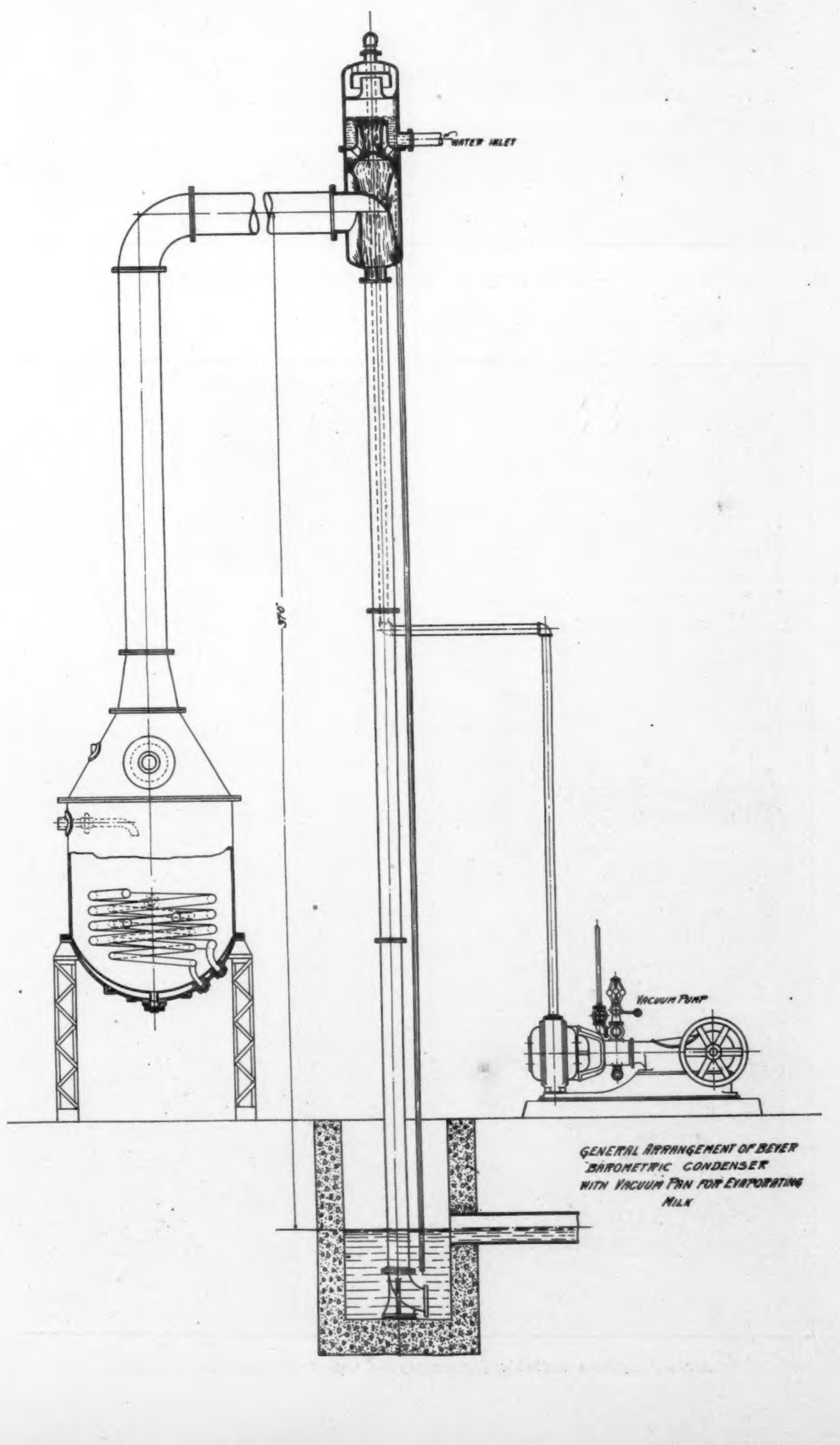
The body strip of tin is run through a machine that bends it into a cylinder, and from there the part is delivered by a conveyer to the soldering apparatus. Next, the soldered body moves on to the assembling mechanism where the top and bottom, with their edges crimped, are forced into position. The succeeding operations alternately solder first one end and then the other—the slightly tilted can rolling first through the flux and then through a shallow V-shaped trough filled with molten solder. So far, so good, but the cans must be tested to make sure that they will not leak when filled with milk.

As the containers leave the last soldering machine they speed down a runway and into recesses set between the double rims of a vertical wheel. Here each can is caught and held by a pair of oppositely-facing rubber discs, and at the same time air under pressure is forced into the can through its filling aperture. Gripped in this manner, the revolving wheel plunges the containers successively into a tank of water. If the soldering has not been perfect, the compressed air promptly finds an avenue of escape, and tell-tale bubbles rising through the water instantly locate the defective can.

At some condenseries the testing is done differently. The cans are picked up by a horizontal wheel equipped with numerous hollow spokes each of which terminates in a suction cup which is brought against the can top and over the filling aperture. At a point in its circular journey on the rotating wheel the container is released so that it will drop if the suction cup cannot hold it. This the cup is not able to do if the can leaks and air enters through any hole—thus neutralizing the effort of the suction. The sound containers, of course, are carried on and are duly delivered to the fillers.

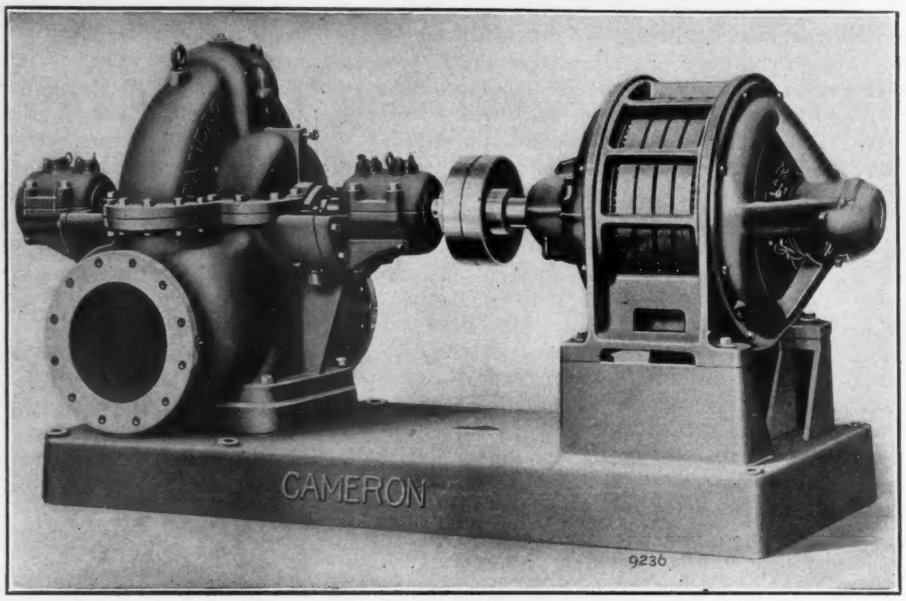
Canned milk was a boon to the army and the navy during the recent conflict, and it has played a conspicuous part in succoring the sick and the under-nourished in distressed Europe, not to mention the afflicted in the famine-stricken districts of China. Indeed, sick or well, millions are benefited the world over by canned milk. Recently, governmental medical experts have shown that condensed milk is likely to help us potently at home in preventing pellagra and in curing the pellagrins in certain of our Southern States where this disease levies its toll upon tens of thousands of the population. Fresh milk is not available to a great many of these people because of the climate and the difficulties of distribution, but condensed milk can be delivered there and kept without fear of spoiling until needed.

A goodly number of us may not be aware of it, but condensed milk makes it possible to satisfy the ever-increasing demand for ice cream. The milk for this purpose is concentrated without the use of cane sugar, and is sold in bulk. This commodity is shipped to the market in 40-quart cans; and it will remain unaffected for a week or two if stored at a proper temperature. The advantage of

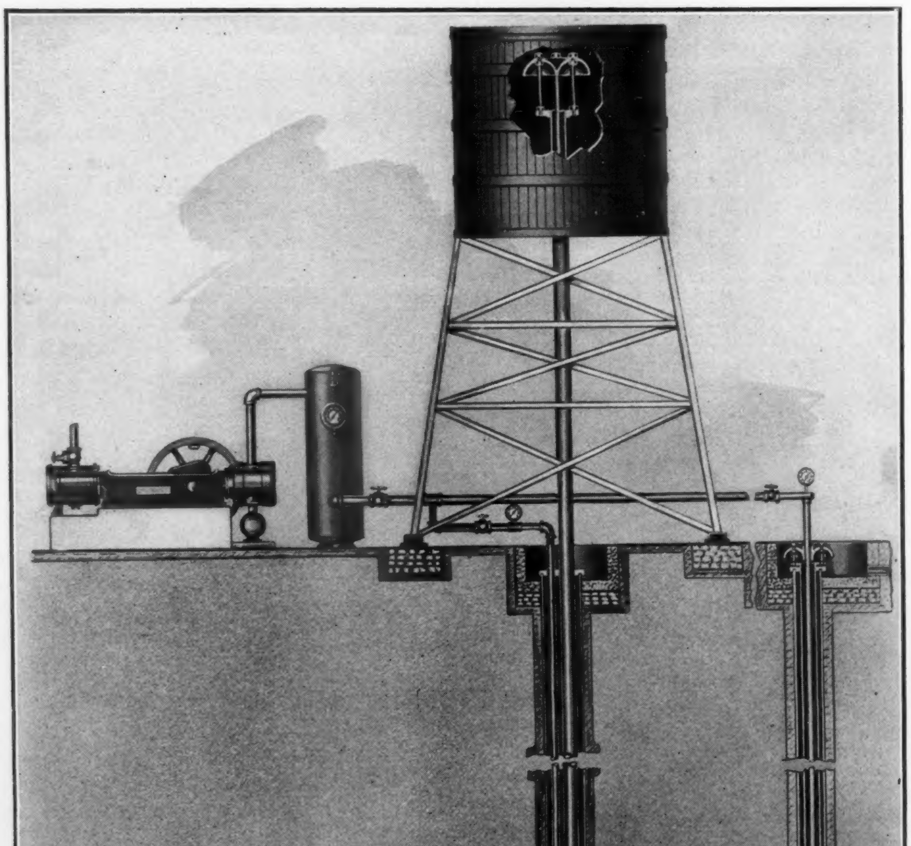


GENERAL ARRANGEMENT OF BEYER BAROMETRIC CONDENSER WITH VACUUM PAN FOR EVAPORATING MILK

this is obvious, and the national sweet tooth is catered to accordingly. It is not hard now to grasp the link between the suction pump and the compressor and the dairy herds feeding upon the lush grass of the valleys watered by streams of crystal purity.



Typical pump for water supply in condenseries.



Air lift system suitable for supplying water for milk condenseries.

HIGH PRESSURES AND GREAT RESULTS

Dr. Georges Claude has evolved radical improvements and developed high economy in the liquefaction of air and in the direct combination of nitrogen and hydrogen in generating ammonia synthetically. Dr. Claude obtains his ammonia in the liquid form, and realizes his ultimate product at an outlay far below that possible where the Haber cycle of operations is employed. He subjects the combining gases to a pressure of fully 900 atmospheres. The first stage of the work involves the liquefaction of air by the well-known Claude equipment, after which the nitrogen is separated from the oxygen by a fractional distillation. The gaseous nitrogen is then mixed with a suitable proportion of hydrogen and compressed to 1,500 lbs. to the sq. in. The next step is to raise this compression to 3,000 lbs., using ordinary compressors for these two stages. In the third operation a new type of compressor is called into service which increases the pressure to 13,500 lbs.—an achievement until now deemed feasible in the laboratory only. Under the best conditions, the Haber process converts into ammonia only from ten to twelve per cent. of the gaseous nitrogen and hydrogen, while for the Claude installation it is claimed it is possible to get three times this measure of ammonia, and the ammonia is delivered directly in the liquid form.

CLEANSING SHIP'S OIL TANKS WITH AIR INSTEAD OF STEAM

When a ship has been used as an oil tanker for some time, there accumulates inside the tanks quantities of poisonous gases. It is, of course, essential to remove these gases very thoroughly before men can go into the tanks to do any necessary repairs. An improvement on the old methods, where steam was used, which was often ineffective, is afforded by an apparatus that does the work with air says *Popular Mechanics* A long canvas tube is lowered into the tank, its bottom end being tightly connected to a nozzle-ended pipe conveying air under pressure. Near this point there are two holes in the canvas tube, and when the compressed air is turned on, it travels at a high rate of speed inside the tube, causing suction at these holes that draws the gases in with the flowing air, and carries them to the upper open end of the tube.

QUICK FUELING FOR PLANES

Air expresses at the London Terminal are to be supplied with gasoline in bulk by a storage pressure system in order to save time in the ground operations of the cross-channel service. Flexible pipes will be carried from large tanks to the airplanes and fed by pressure, eliminating the previous method of employing mechanics to empty can after can into the machine.

The filling by hand of the tanks of a 450-horsepower, eight-seater air express takes nearly one and a half hours, but it will be possible to replenish them in about fifteen minutes by the new system.

The Present Status of the World's Platinum

Colombian Production Replacing the Depleted Russian Output—Operations in Colombia Now Carried on by Two Modern Dredges to be Increased to a Larger Scale

By RICHARD HOADLEY TINGLEY

VARIOUS AUTHORITIES place the total production of platinum in the world to date at between four million and five million troy ounces. Assuming four and one-half million ounces as a fair average, at today's prices, about $73 per ounce, this would represent a value of $328,500,000. If the entire supply could have been marketed at the top-notch price of 1919 (and, of course, it couldn't) the princely sum of $765,000,000 might have been realized, for during that year the price advanced for a short period as high as $170 an ounce.

But a large portion of this platinum was mined and marketed when the price was low; before chemists and metallurgists discovered its valuable qualities in the arts, and before fashion set its stamp of approval on the metal as a perfect setting for precious stones.

One of the foremost authorities of the country, Dr. Frederick Kunz, of Tiffany & Co. New York, has termed platinum, one of the two "noblest of metals," its associate, of course, being gold. Nobody thought of calling it "noble" however, in the old days of placer washings where the yellow metal was sought—on the other hand, not knowing what else to call it, they called it a "nuisance," and threw it away. They threw it back into the beds of the Colombian rivers—for it is in what is now Colombia that platinum was first discovered—and big modern dredges are now scooping it up again along with other virgin nuggets. They threw it into the streets and yards of the villages, and this habit caused no end of excitement for the natives of Quibdo some twenty years ago when platinum prices began to mount and the get-rich-quick fever ran its course. The entire town was panned, the government claiming the right to operate in the streets. The natives panned the yards, however, with rich results in many cases. One enthusiast with a good memory burned his house to the ground for the platinum he knew was under it. Out of the proceeds of his heroic treatment he is said to have rebuilt his house and banked $4,000 in gold besides.

In view of the many uses to which platinum is now put and of the fact that the early Spanish adventurers must have encountered it in their mad search for gold, it seems strange that the first recorded knowledge of its existence dates back no further than 1735 when Don Antonio de Ulloa visited that part of South America now known as Colombia.

From that time on, European chemists began to experiment with it in endeavor to determine its usefulness and many were the difficulties they encountered in trying to solve the riddle of a metal containing so many hitherto unknown qualities. Its specific gravity was fairly established by William Lewis of London in 1854 at 18.213. Mr. Lewis adds in his report to the Royal Society of London, however, that if he were able to still further purify the metal, its weight would probably be increased. (The specific gravity of pure platinum is now determined at 21.5).

In 1783 the first platinum ingot was made by Chabaneau, a French chemist, in the form of a cube of about four inches, weighing about 50 pounds. Chabaneau created quite a sensation when he exhibited the ingot, its extreme weight leading his audience to believe it to be fastened to the table.

That platinum was known to the aborigines of America is evidenced by the findings of Mr. D. C. Stapleton, of ornaments made of this metal in the tombs of the Incas in the Province of Esmeraldas, Ecuador. Most of these are small and are perforated for attachment or stringing and may be described as circular or elliptical spangles. The ornaments are made of gold and platinum combined, one or two thin layers of the latter having been hammered onto a thin layer of gold. They are thought to be at least 2,000 years old, though this is purely speculation. Similar ornaments have been found in the prehistoric graves in the island of Tola at the mouth of the Santiago river, Ecuador. Many of these relics are now on exhibition in the Museum of Natural History in the City of New York.

Little progress was made in the discovery of platinum or its uses till the year 1819 when the metal was found in the gold mines of the Dakovlov district in the Ural Mountains, Russia. Closely following this other Ural deposits were discovered and platinum began slowly to assume its place in commercial history with Russia as the leading producer.

Courtesy, Jewelers Technical Advice Co., N. Y.

Application of the gas-oxygen jet to the melting of platinum in crucibles as practiced in most jewelry shops.

Platinum Operations in Colombia

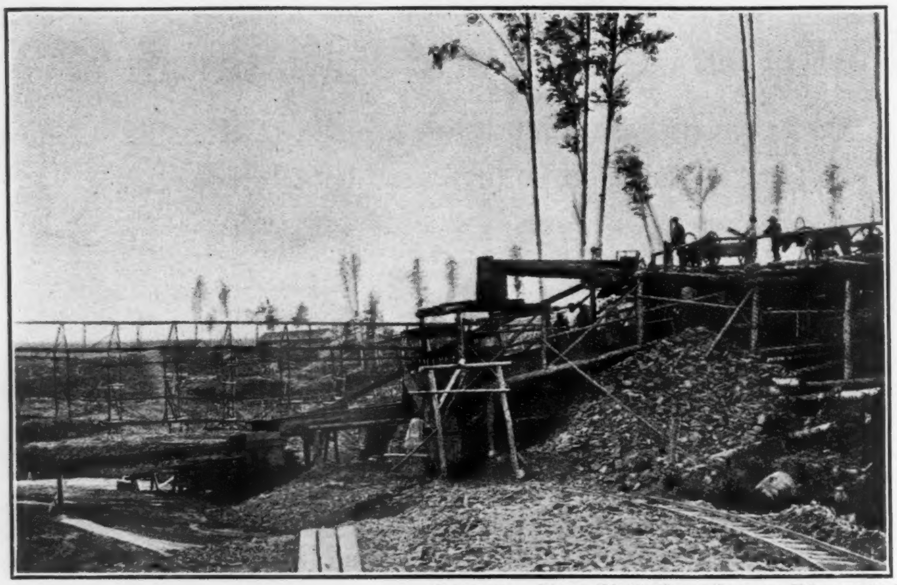
Although Colombia has long held place as the second largest producer of the world's platinum, its volume, until recently, has been small when compared with that of Russia. Stimulated, however, by a demand that looked it squarely in the face because there was no other place to look, venturesome capital has been intensively exploiting the rivers of that country and has succeeded in increasing the output to respectable proportions although still but a portion of Russia's former performances.

At the head-waters of the Condoto, high up in the Andes Mountains, is the ledge rock which has been found to be the source of the platinum, but it carries such infinitesimal quantities that nature has to be relied upon to wash the metal down and concentrate it in the river-beds and adjoining banks before it can be profitably extracted.

Except in one other case of quite minor importance, in British Colombia, no "mother lode" of platinum has ever been located—all platinum mining being done by placer washings—by hand panning in the old days and in the small operations of today—by big steam dredges in the larger operations that scoop up the river bottoms with huge buckets. The Canadian "mother lode" to which I refer is briefly described by the United States Geological Survey as being at the head of the Tulameen River, near the United States boundary, on the slopes of Mount Olivene. It is probably of small extent and value since knowledge of its existence dates back several years, and it has never been worked commercially. The bed of the Tulameen River, however, has been and still is being panned in a small way for platinum and gold.

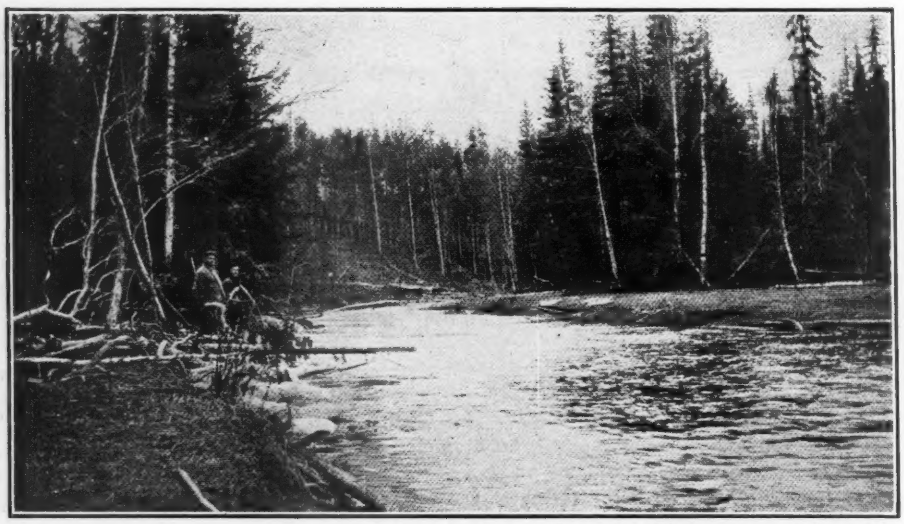
By far the most ambitious and businesslike operations in platinum mining now being carried on are those of the South American Gold and Platinum Company in Colombia. This company controls an extensive territory along the San Juan and Condoto Rivers in the Choco district, all of which is, or will be, developed for platinum. Although the company owns concessions covering fully 200 miles of rivers, the portion now being worked consists of about 50 miles of river bed together with some 10,000 acres of adjacent alluvial deposits. Access to the property is had by the San Juan River which is navigable by steamers.

The company, at present, has two dredges in operation. One of these, with an annual capacity of 400,000 cubic yards, has been



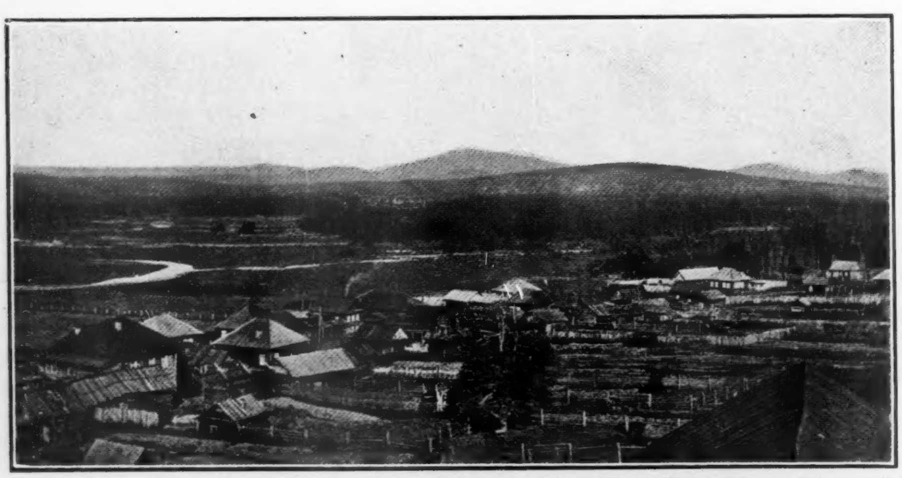
Courtesy, Gites Platiniferes-Duparc-Tikonowitch.

American type of sluice in operation at the Petropavlovsky placer mine on the River Iss.



Courtesy, Gites Platiniferes-Duparc-Tikonowitch.

River Mourzinka near its confluence with the Liala on the Pavdinskaya concession.



Courtesy, Gites Platiniferes-Duparc-Tikonowitch.

Confluence of the Rivers Pavda and Berezowka, at the village of Pavda.

working for three years. The other began operations in August, 1920, and has an annual capacity of 1,000,000 cubic yards. A third dredge of capacity of about 1,500,000 cubic yards a year is now being assembled and is expected to be at work during the coming summer or early fall. These last two dredges are quite the "last word" in construction and efficiency. Built almost entirely of steel in the United States, they are shipped "knocked down" to Colombia where they are assembled—a complete air compressing outfit being used in riveting the parts.

Pits and borings have disclosed the existence of sufficient gold and platinum for profitable operations for many years to come, and it is the announced intention of the company to continue the installation of new dredges as development work progresses. The values recovered based on the work of the first dredge have been distributed as follows:

	Platinum oz	Gold oz.
1918	6,184	701
1919	6,349	972
1920	6,939	1,356

While the company does not attempt to forecast 1921 results, it is understood that its current production is running at the rate of from 400 to 500 ounces of platinum per week, and from 50 to 100 ounces of gold.

The region under review is tropical and torrential rains occasionally cause heavy floods. After every flood new values are found, showing that enrichment is still in progress from the "mother lode" up in the mountains. But the greatest values lie against the bed rock from ten to 30 feet below the bottom of the rivers. Only modern dredges can reach this gravel, and the bed rock is soft enough to be cut—the buckets digging into it from six to eight inches, bringing up all possible values with a minimum of waste.

Operations are now centered at Andagoya, about 185 miles up the river from the Pacific Ocean, at a point where the Condoto enters. The work is progressing up-stream because values increase in that direction. It will be understood that, on account of the greater weight of platinum, it is not carried as far down the river as the gold. About one and a half per cent. of osmiridium is recovered with the platinum in the San Juan and Condoto.

Platinum in the United States

I have described the Colombia operations somewhat in detail because it is the only mining of platinum now being conducted on anything like a large scale or on business principles—indeed, it is almost the only hope of the world for its platinum supply of the near future. When in operation, however, the rivers of the Ural were mined in much the same manner—and they may be again when Lenine really reforms, and when Russia again gets to work.

The United States has been a disappointment to seekers for platinum. Somewhere up in the Coast Range of Mountains in Oregon or Northern California, there is probably another "mother lode," though none know where. It has long been known that the so-called "black sands" of the Pacific, at the mouth of the streams flowing down from these mountains,

Courtesy, American Numismatic Association, N. Y.

A three Russian ruble piece of platinum of the coinage of 1828.

contain platinum values along with gold. During the war when platinum was scarce and in great demand in the manufacture of munitions, intensive and efficient search was made, both by government agents and private prospectors, to mine these sands commercially. Failure, however, accompanied these endeavors. The metal was there as all agreed but not in paying quantities.

Diligent search, also, has been made for platinum in Alaska and more or less mystery surrounds the situation with respect to its platinum deposits. In 1916, the Geological Survey reported about twelve ounces shipped from Koyuk, Chistochina and Fairhaven districts. In 1918, the output of platinum, palladium and other metals of the platinum group was 284 fine ounces, valued at $36,600, while the values of platinum and allied metals mined in Alaska in 1919 and 1920 were $73,663 and $80,000 respectively, as reported by the Geological Survey.

Placer mines of California yield small values of platinum, producing as high as 460 ounces in 1917, and 530 ounces in 1918. Nevada, Oregon, Washington, Arizona and Idaho also contribute every year to the United States quota. It is evident, however, that, up to the present time, there has nothing come to light within our borders or those of our dependencies, which warrants belief that this country will ever be self-sustaining so far as platinum is concerned. We must look to Russia or Colombia—probably the latter—for some time to come.

Strange as it may appear for there is no accounting for the freaks of nature, the richest sample of platinum earth ever found in this country came from the Piedmont section of North Carolina about fifteen miles south of Danville, Virginia. This is an agricultural region far removed from the mountain section of that state. In this case North Carolina upheld its reputation for producing a greater variety of precious metals and minerals in non-paying quantities than any other state in the Union; a veritable *ignis fatuus* that has lured many an over-optimistic miner to his ruin. In 1898 there was discovered extremely rich platinum dirt in the neighborhood referred to. The find, however, proved to be only a "pocket," and in rich "pockets" North Carolina abounds.

It is stated by Duparc, an authority on Russian platinum, that, even before the war, the placer washings of the Ural Rivers were becoming depleted and that the old mines could not last many years longer at their then rate of production. It has been further stated that, should Russia begin to-day to redevelop her platinum mines it would take years to work up to anything like her old volume of production. The best of authorities state that the big dredges are practically in ruins—rusted and badly depreciated owing to long continued idleness.

The Uses of Platinum

Of the various uses to which the world's stock of platinum has been put, the following estimate by Dr. Kunz may be regarded as approximately correct:

For catalyzing	400,000 ounces
Dental purposes	1,000,000 ounces
Chemistry	1,000,000 ounces
Electrical work	500,000 ounces
Jewelry	500,000 ounces

The 400,000 ounces devoted to catalyzing purposes have been distributed, according to the same authority.

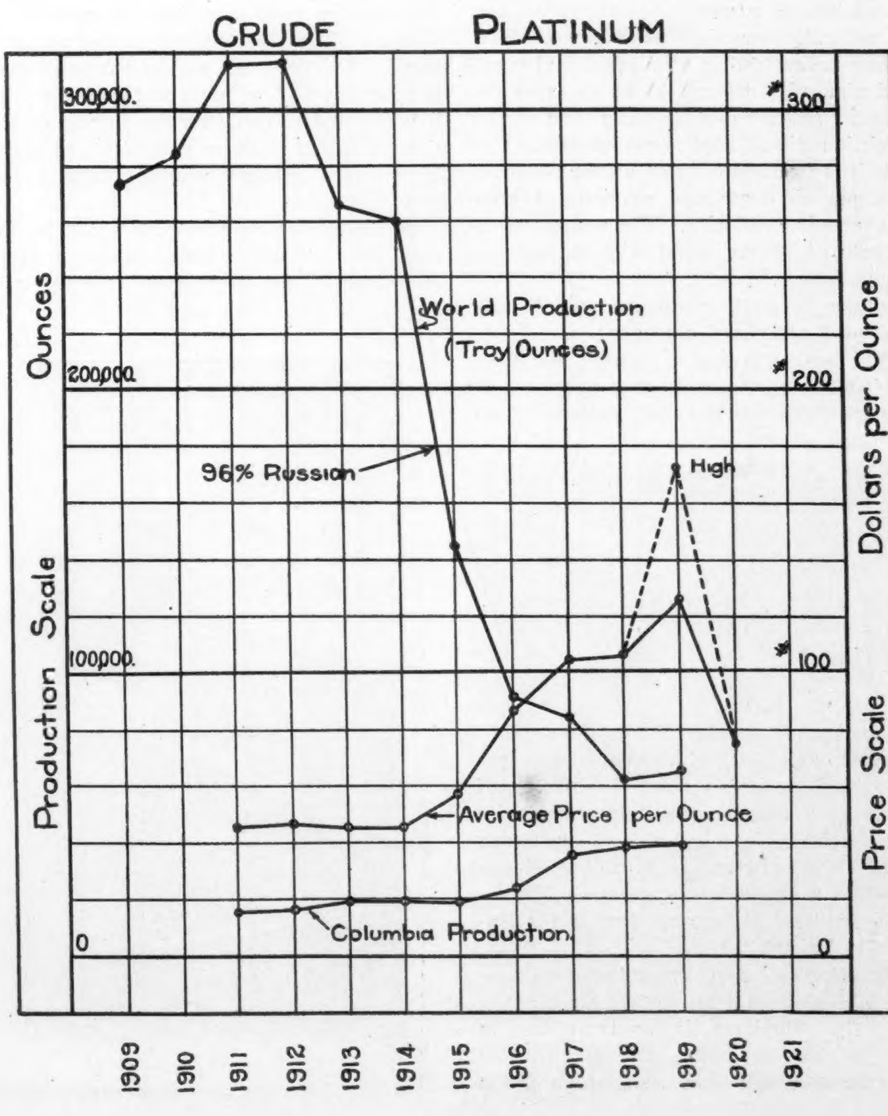
To the United States	200,000 ounces
England	100,000 ounces
Germany	70,000 ounces
France	30,000 ounces

The largest uses, says Dr. Kunz, have been for dental purposes and for chemical and physical equipment; its uses for dental purposes and jewelry have been about equally divided. The net amount worked up into jewelry probably does not exceed 500,000 ounces, although total sales may have reached 1,000,000 ounces, but a large quantity of this is returned to refiners and again used.

Courtesy, Baker & Co.

This platinum nugget came to Baker & Company, Newark, N. J., in 1897 from South-America. Its early history is doubtful owing to repeated changes of ownership. It is the largest nugget ever found on this side of the Atlantic and was exhibited at the Panama-Pacific Exposition in San Francisco in 1913 where it was stolen and never recovered. It has probably long since been melted down. It weighed nearly two pounds and would be worth at present prices about $1,750. The world's largest nugget of platinum was found in the Ural Mountains and is said to have weighed eighteen pounds.

The method of refining platinum employed in the United States assay office is described as follows: "In the electrolytic process of refining gold, platinum remains in solution in the gold



Courtesy, American Patinum Works, Newark, N. J.

Analytical laboratory in a platinum refining establishment.

chloride electrolyte, from which it is precipitated by means of ammonium chloride. The precipitate is then well washed and reduced at a red heat to a metallic platinum sponge. This naturally contains impurities, and is therefore redissolved in aqua regia, and evaporated almost to dryness, so as to expel the nitric acid, sulphur dioxide being then passed through it until all gold is precipitated. Upon this it is oxidized to bring all the platinum into a platinic state and precipitated with pure ammonium chloride. The precipitate is then reduced in the usual way to metallic platinum sponge."

Platinum is most useful in making sulphuric acid and fixed nitrogen; for lightning rod tips; coloring of pottery and photographs, and the preservation of standards of measurement. Dentists use it because it does not tarnish or oxidize. No acid other than aqua regia will affect it and for this reason it is in general use in chemical laboratories and apparatus. Platinum used in electrical work is often alloyed with as high as 50 per cent iridium, and each telephone and telegraph instrument has platinum contacts.

Every high-grade magneto for an airplane, automobile, motor boat or gas engine has from two to six contacts of platinum, and there are a multitude of platinum contacts on all telephone switchboards and relay instruments. Combined with ten to twenty per cent of iridium, it is one of the hardest of metals. Platinum may be drawn into wire of almost invisible fineness, and one cubic inch of pure platinum is capable of being drawn into a single wire 50,000 miles long—twice around the globe, according to the Encyclopedia Britannica!

Its melting point is 1,775 degrees Centigrade which is equivalent to 3,227 degrees Fahrenheit. Platinum is used as lead-in wires for electrical bulbs, and with iridium forms the material from which high grade pen points are made. One of its chiefly valuable characteristics is that it is unaffected by all ordinary acids. It is for this reason that dentists employ it since the acids of the mouth will, in time, destroy almost any other metal. For the same reason surgeons use it in replacing broken bones and during the war it performed valuable service in this connection. Without platinum many lives of severely wounded soldiers would otherwise have been lost.

In addition to its spectacular use for surgery and for firing fuses, platinum played an important part in the war. Without it the Allies would not have been able to make sufficient explosives or poison gas. The modern quick way of making nitric acid and fuming sulphuric acid is through the use of platinum as a catalyzer. Chemists cannot explain just why, but it is a fact, that only when in contact with platinum will certain chemical changes take place.

Platinum in Jewelry

The use of platinum in jewelry dates from not more than 25 years ago. When the metal was low in price fashion paid but little heed to it. As the price mounted, however, the *Beau Monde* became interested and, with its stamp of approval set upon the metal, it quickly came into great demand. The jewelry trade is now said to use approximately 50,000 ounces a year—not all new metal because the present supply will not permit—but scrap, and in connection with many alloys. The use of the "noble metal" in jewelry has been called a fad; a fashion that will soon pass. A fad because it is expensive.

On this point, however, there is a divided opinion. Most people agree that, as a setting for diamonds, platinum has no equal. There is certainly no metal known to the arts that will impart the appearance of quality as well as platinum, and it does not oxidize or discolor. With the proper admixture of iridium, platinum forms a metal of such hardness and toughness that gossamer webs, scarcely visible to the naked eye can be drawn from it subjected to quite rough usage without serious injury. For this reason it is in demand for making the intricate and expensive designs in jewelry.

Jewelry shop practice has undergone important changes within recent years, according to Miss Calm M. Hoke of the Jewelers' Technical Advice Company of New York and an acknowledged expert in this line of work. Shop foremen had experience in handling

Courtesy, Jewelers Technical Advice Co.

Typical equipment for the melting of platinum.

Courtesy, South American Gold & Platinum Co.

Dredge No. 2 of the South American Gold & Platinum Co. now operating in Colombian rivers scooping up pay gravel at the rate of a million cubic yards a year. The parts of this big steel dredge, as well as of another that will soon be in operation, are assembled at the river sites where they are to work and riveted together by the use of a complete outfit of air compressing machinery and pneumatic tools.

gold before that and, when platinum came to the front, naturally attempted to handle this metal in the same manner. They soon found this difference: gold melts with gas and air, while platinum is melted with gas and oxygen under pressure: gold is cast, while platinum is wrought; gold is easily purified by fire, while platinum is not, but requires the intense heat from a gas-oxygen torch to purify it.

It was slow work developing platinum until it was learned by experience that the gas-oxygen torch was the proper agent and now 99 per cent of the jewelry shops in the country melt their platinum by this method.

"Production of Values"

The years 1911 and 1912 saw the peak of production of platinum when slightly more than 313,000 troy ounces were mined in each of these years, 300,000 ounces, or 96 per cent., coming from the Ural Mountains in Russia. Colombia, South America, came next with 12,000 ounces, and the other thousand or so came mostly from this country, New South Wales and Tasmania. As a producer of crude platinum, therefore, the United States is a negligible factor. Since 1912, platinum production has been on the toboggan slide, chiefly owing to war and anarchy in the principal producing country.

The following table will tell the story in figures, which are compiled from reports by Mr. James M. Hill of the United States Geological Survey.

ESTIMATED WORLD'S PRODUCTION OF CRUDE PLATINUM

(1909-1920; Troy Ounces)

	Russia	Colombia	U. S.	Elsewhere	Total
1909	264,000	6,000	672	970	271,642
1910	275,000	10,000	390	562	285,952
1911	300,000	12,000	628	500	313,128
1912	300,000	12,000	721	808	313,529
1913	250,000	15,000	483	1,750	267,233
1914	241,200	17,500	570	1,278	260,548
1915	124,000	18,000	742	403	143,145
1916	57,860	25,000	750	60	83,670
1917	50,000	32,000	605	462	83,067
1918	25,000	35,000	647	1,636	62,283
1919	30,000	35,000	824	1,356	67,180

Platinum heads the list of a group of precious metals with which it is usually associated in nature—iridium, osmiridium, osmium, palladium and rhodium. When associated, however, platinum always largely predominates in volume although not always in price. This average ratio is best illustrated by quoting the imports of these metals for the year 1919 as given by the Bureau of Foreign and Domestic Commerce:

IMPORTS OF PLATINIFEROUS METALS—1919

	Troy Ounces	%	Value, $	Ounce Value, $
Platinum	54,550	80	5,229,309	95.86
Iridium	5,808	8	975,174	167.90
Osmiridium	1,374	2	112,430	81.80
Palladium	3,739	6	250,777	67.07
Osmium	2,339	4	132,097	56.47
Rhodium	222	..	30,474	137.25
Totals	68,032	100	6,730,234	98.93

In the early part of the last century, after the discovery of platinum in the Urals, according to Dr. Kunz, the Russian government issued a platinum coinage, their intrinsic value being reckoned at "less than six times that of silver, and only a little more than a third of that of gold," whereas, in the year 1919, platinum sold at eight times the value of its weight in gold. The Russian coinage began in 1828, in the reign of Nicholas I, and consisted of three, six and twelve ruble pieces.

In 1845 the further coinage was stopped by an ukase because of the rise in value of platinum and the consequent exportation of the coins for their metal, rather than their ruble worth. In all there were 1,393,012 coins struck containing 473,907 troy ounces. The nominal worth of the coins was about $3,000,000, but the metal in them would be worth to-day, May, 1921, approximately $34,000,000. It is probable that the rising price of platinum has caused the melting down of most of these coins for they are extremely rare and are found only in museum collections, some of which are in the American Numismatic Association of New York City.

It has been recently stated that the Soviet government of Russia proposes now to issue a new type of credit note backed by reserves of platinum of value of 37,500,000 rubles and thus, again monetize platinum.

The precursor of the legal Russian coinage of platinum was the counterfeit coinage of Spanish doubloons. A piece of the same size was struck in platinum and the surface was then gilded; as the specific gravity of the only partly refined platinum was approximately that of gold, these spurious coins could be circulated without much difficulty. Paradoxically enough, also, there are many other instances of counterfeiting gold coins by using platinum as a base—such coins, if they were now in existence, being worth as metal many times their spurious value as coins. Paradoxically again, now that platinum is worth so much more than gold, owners of old gold rings and other ornaments are having them plated with platinum in order to conform with the prevailing mode.

No further back than 1916 it was estimated by Mr. Hill of the Geological Survey, that the United States alone used 165,000 ounces of platinum a year. Since that time, and during the war, the Government consumed a large quantity of the metal, being obliged to practically commandeer much of it from the jewelry trade and from private citizens. About 25,000 ounces of this was turned back into commercial channels at the close of the war

Courtesy Jewelers Technical Advice Co., N. Y.

Close-up view of a Hoke-Phoenix gas-oxygen soft flame jet.

which tended to relieve the situation at that time. The Government fixed price was $105 per ounce.

It is most evident now that this country cannot be using platinum in the old pre-war volume as the production figures, I have given will testify. The result has been that many substitutes have been introduced and platinum is being alloyed more and more with other metals. With new uses for platinum being constantly discovered and with a decline in production to but a quarter of the pre-war volume, it would be natural to expect a shortage in the supply and advancing prices. Such, however, does not seem to be the case as the price has held firm at around $73 for some time past.

One Maiden Lane dealer was heard to remark not long ago that, were he to publish the fact that he was in the market for platinum at $75 an ounce, his place of business would be flooded with the metal. This indicates that the market is over, rather than understocked—much of it, too, representing a price to the owner in excess of the present market.

The exact stocks held by the various dealers and refiners is difficult to ascertain. Such information is kept as a trade secret. One refiner, however, has ventured to estimate that upwards of 50,000 ounces are at present held in this country and a like amount in England. If these figures, amounting to little better than a guess, are anything like correct, it will not be reasonable to expect higher platinum prices right away.

PNEUMATIC HANDLING OF SMALL COAL

The success with which grain is dealt with at shipping ports by compressed air in pipes suggested the application of that method, and an installation, which has now been in constant operation for more than two years, was designed and constructed at Brunswick (Germany) to transport 50-60 tons of "nut" coal per hour from the washing-plant to the boiler-house, about 100 yards away. A double-action air-pump lifts the coal by suction into the conveying pipe and then by compression forces it through to the point of delivery, over the bunker in the boiler-house. To transport 60 tons of this coal per hour requires about 80 h.p. An air-vessel inserted in the pipe line serves to equalize the pressure and to maintain a regular flow of coal. Wrought-iron pipes have been found to wear rapidly, and these will be replaced by cast-iron pipes. The system is not applicable to the transport of round or run-of-mine coal economically, but for fine coal its use is extending, and its speedy adoption for blowing fine coal directly from the washing-plant to the coke ovens may be looked for. Where the distance is not too great and the line is straight and not at a high angle, the band conveyor is more economical of power; but when the angle is high and the line from point to point is crooked, the pneumatic system is preferable.

Our mines, including bituminous and anthracite, yielded 646,000,000 tons in 1920.

TUNNEL UNDER THE ELBE AT HAMBURG

THERE HAS recently been completed at Hamburg, Germany, a tunnel, or, rather, twin tunnels with a number of interesting features. The tunnels are 1,500 feet long, each twenty feet in diameter, and very close together, 26 feet three inches between centers. There are no roadways approaching these tunnels, but at their ends on each side of the river and serving both tunnels there is a well 72 feet in diameter with six lifts in each, three of which 10 by 33 feet are for vehicles up to ten tons, the other three being passenger lifts with a capacity of 14,000 passengers per hour.

The tunnels were driven by the shield process with a novel type of lining which consisted of steel segments riveted together instead of the usual cast iron and bolts. Six segments with strong flanges on the sides and ends, the cross-section being similar to a girder ten inches high with flanges wider on the inside than on the outside, complete a circumferential ring. The inner surface of the flange is provided with a groove into which lead jointing material is caulked whilst the space between the lining and the soil is filled with cement grout in the usual manner. Each tunnel, which has a central roadway six feet wide for vehicles and a footpath on either side, is for traffic in one direction only.

The circular well on the town side was constructed of reinforced concrete in an open circular ditch, seven feet three inches wide and 98 feet six inches deep, carried down to a strata of solid clay, the main wall being built of plain concrete, covered on the outside with strong sheets of asphalt with a lining of hard burnt bricks set in cement. The inside "dumpling" of earth was then removed, the walls finished off and a circular superstructure with a large glass dome erected over the well. The hoisting machinery for the lifts is placed under the dome. The corresponding well on the harbor side of the river had to be sunk through a layer of water-bearing sand and gravel by means of compressed air, and a double-walled steel cylinder 85 feet in diameter. The working chamber at the base, with an air pressure of 35.5 pounds per square inch, was 33 feet high, and provided with a strong cutting edge. The space between the double walls of the cylinder was filled with concrete, and the walls were riveted together as the work proceeded. Four air-locks were used, one for personnel and three for materials.

The fine sand from the internal excavation was removed by means of the constantly escaping compressed air through a discharge pipe, carried down to the bottom of the excavation.

One serious "break through" of compressed air into the river occurred when the upper cover over the tunnel gave way, the air pressure disappeared, and a vast quantity of water and sand entered the tunnel, fortunately, however, without loss of life.

The high air-pressure adversely affected the workmen who, in the first instance, were required to pass a stringent medical examination. Of a total of 4,400 workmen, four deaths, 74 severe and 615 light cases, occurred.

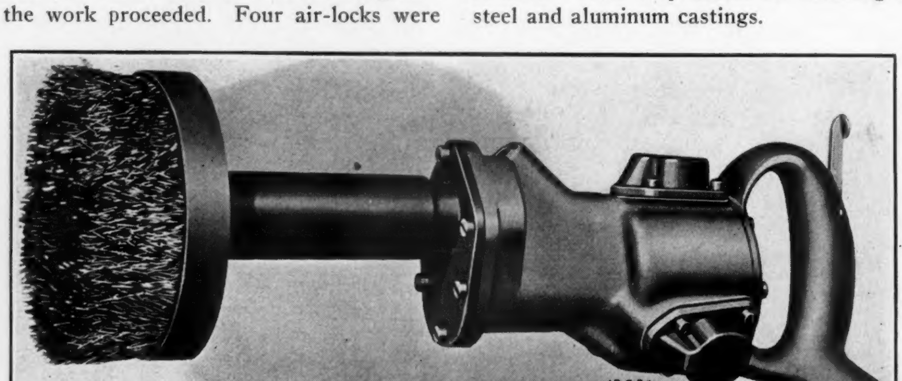
AIR DRIVEN WIRE BRUSH FOR METAL CLEANING

WIRE BRUSH cleaning of metal surfaces offers an opportunity for considerable saving of time and labor over that required by hand in removing paint, rust, scale and dirt. However, it has been difficult to obtain a wire brush of proper design and materials which would work effectively on an air motor and not wear out too rapidly.

A wire brush of very rugged design has recently been placed on the market by the Ingersoll-Rand Company, 11 Broadway, New York, for use with its standard No. 6 "Little David" Drill. It is a brush with face diameter of five inches and is made up of wires of a special heat treated steel which has been found to have very good wearing qualities. It is sturdily constructed and will stand up under severe service.

It is manufactured particularly as an attachment for the No. 6 Drill (as illustrated), this type of machine being especially suited for work of this nature. The drill has liberal bearings to take up all the end thrust when pressing down on the work; a high speed and very reliable motor, and moreover is of light weight and small overall dimensions. It can be used in sharp corners and other cramped spaces. The whole outfit weighs only 11½ lbs.

The wire brush outfit is adapted for removing paint, rust, scale and dirt from tanks, steel cars, structural steel and all sheet metal surfaces. It is very useful for cleaning iron, steel and aluminum castings.



"Little David" wire brush.

Advantages of Using Timbered Rill Stopes

Elimination of Mucking Operations and Introduction of Waste Filling into the Stope Without Handling Result in a Large Saving of Cost Per Ton

By H. L. BICKNELL

IN ORDER to complete the discussion commenced in the July issue of the COMPRESSED AIR MAGAZINE on rill stoping methods in the Butte District Mines, this second article describing the timbered rill stopes has been written.

Where veins are found to be ten feet or more in width the method of open rill stoping becomes extremely difficult and often very dangerous. For this reason an attempt was made to use timber in stopes in the wider veins following the idea of the open rill system of stoping. This proved to be very successful after the first attempts had been changed and adapted to the timbering idea, some of the stopes being worked at almost as small a cost as was attained in the open rill stopes. This was probably due to the higher grade of ore found in these wider veins which could be broken two sets wide by one round.

These stopes as well as open rill stopes were usually contracted, the basis of pay being a price set per cubic foot of ore blasted and delivered into the ore chute. This price includes the timbering and laying of ore slides on the waste slope. An extra price was given the contractors per set of chute lined when raising the chutes in the center stope raise.

The drawings illustrating the methods described in this article include the following: No. 1 shows the practice used in holing a rill stope development raise to the level above. No. 1-A is the plan of a drift showing development for timbered rill stopes, both above and below. This drawing also shows the method of obtaining waste for filling the timbered rill stopes below by driving the lateral drifts. No. 2 shows the preliminary development of the timbered rill stope. No. 3 gives a good idea of a square set which is used to support the back and walls of a timbered rill stope. No. 4 shows the timbered rill stope after development and as it is carried up toward the upper level.

The preliminary development necessary for timbered rill stoping is about the same as for open rilling. Drifts are driven two hundred feet apart vertically along the vein. These drifts are offsetted for raises every eleven sets, the twelfth, thirteenth and fourteenth sets being made two sets wide, then driven ahead for eleven sets and widened again for three sets.

The offsets are always made into the foot wall of the vein, and are for the purpose of starting raises. An extra set in width is always necessary to accommodate the mouth of an ore chute. It is also a rule in Butte that all ladder ways shall be offsetted one set to the side of the drifts in order to prevent any accident which might occur from tools or rocks falling down the manways.

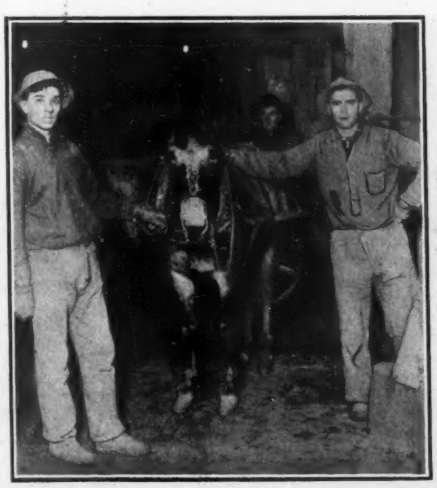
A TIMBERED rill stope combines the open rill stoping with the square set method. It is used in wide veins where the ore body and walls are not firm, needing the support of timbers.

It has the advantages of the open rill system in that mucking is eliminated and the cost for filling is very low on account of the fact that the waste is poured directly into the stope from the level above without any handling in the stope.

It is a cheaper and more efficient method of mining than square setting and it has most of the advantages of open rill stoping.

It is necessary in driving the drifts to construct switches usually every five hundred feet. To do this the drift is driven two sets wide for about ten sets and the proper long caps are put in at the beginning and ending of the wide portion in order to accommodate the switch which joins the main track at both ends. Outside of the two long caps at each end of the switch, regular sets of timber are used for the rest of the timbering done between the two ends.

These switches are about long enough to hold ten cars, which is necessary for the mucking in the drifts and also the switches come in very handily after the development is complete as trains of ten or more empty cars can be left on a switch above a full chute and the cars loaded by loaders, trammed to a lower switch and hooked up. This makes it possible for the motor crew to pick up the loaded train, leaving the switch full of empty cars and aids considerably in the speed with which the ore can be moved to the main hoisting shaft.



The lady mule that chews tobacco but is also a valued and faithful mine hand.

Raises are started in alternate offsets, beginning with the first, as soon as the drift has been driven far enough ahead so that the two operations of drifting and starting the raise will not conflict. These raises are contracted and driven through to the level above. When they are within 30 or 40 feet of the upper drift they are driven up straight into the hanging wall so that they will hole on the upper level several feet into the hanging wall side of the upper drift. It is customary to make the top sets of the raise at least fifteen feet from the hanging wall drift posts. This not only makes it possible to lay a track to the top of each chute for the future dumping of waste but it also makes room for piling timber for use in the stopes directly below. A section of the top of a rill stope raise is shown in Figure 1.

After the raises have progressed upward for five or six floors, the first floor, between the first two rill stope raises is mined. This is usually started at the raise nearest to the shaft. It has been found best to have the raise men, mine and timber the first set each way along the drift from their raise on the first floor as the raise is carried up. This makes it much easier to start mining out the first floor later.

The floor is mined out from the raise toward the center chutes, all ore being broken on "stop boards" and mucked into cars on the track below. The timbers used for the square sets in the stopes are round framed timber with the exception of the timbers directly over the three sets of drift and the three side sets at the center chutes. These are timbered with 10x10-in. posts, caps and girts. The reason for this is that the square timbers are best adapted for chutes and manways. They are always straight and make a good even backing for the chute lagging.

As the first floor is taken out, just above the drift, holes are also drilled into the footwall long enough and so pointed that footwall caps and girts can be laid on the ledge of solid rock formed by the blasting. The top of the first floor therefore is two sets wide across the vein and on the second floor of the stope it will be possible to have three posts across the stope, which would probably take in the whole width of the vein. This method of offsetting the stope, is shown in the small section A-A in Fig. No. 2.

The second floor is also mined and timbered in the same way, allowing the ore to fall to the first floor where it is mucked through the stop boards into cars.

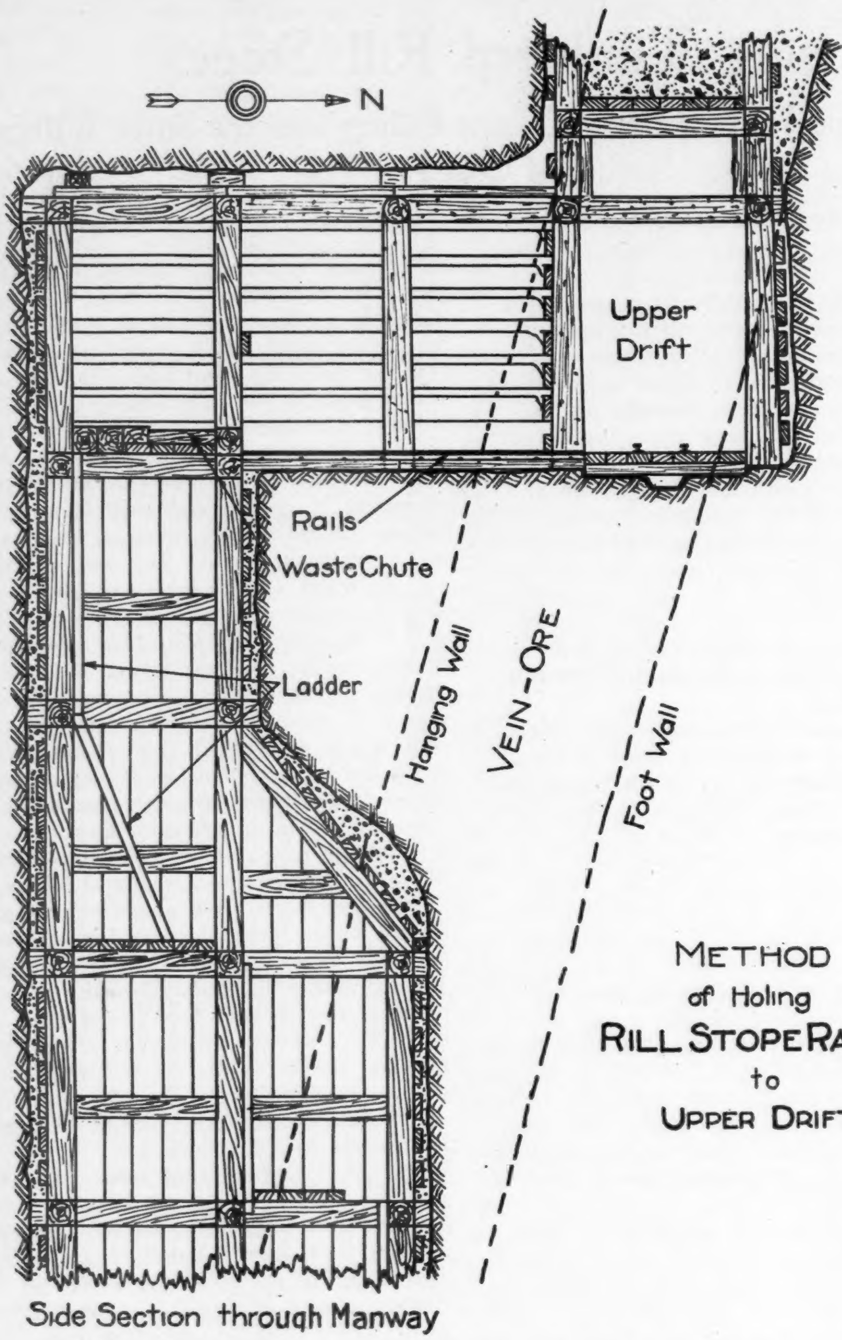


Fig. 1. Shows the practice used in holing a rill stope to the level above.

When the first and second floors are complete between the two rill stope raises, mining is stopped until the ore is all cleaned out and the sheeting timbers put in on top of the drift timbers through the entire length of the stope. The center chute mouths are built and the chutes cribbed up to the second floor. Gob lagging is nailed to each stope side of the rill stope raises and the center chutes up to the second floor, in order that from this time on all ore broken in the stope can be sorted and the waste thrown down into the "gob," which is supported by the sheeting.

The next step in developing the timbered rill is to give the stope, on each side from the center chutes to the raises, the proper

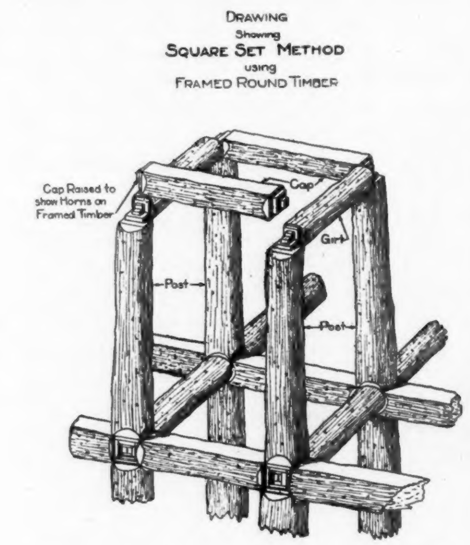


Fig. 3. Square set for support of back and walls.

angle for the rilling method. One way to accomplish this is to start the third floor on either side of the center chutes, in the third set toward the rill stope raise. When this set is mined and the four post square set is in place, the third floor is carried on over until it connects with the rill stope raise. Then the fourth floor is started, two sets closer to the rill stope raise and carried over to this raise. The fifth, sixth and seventh floors are mined in the same manner, dropping two

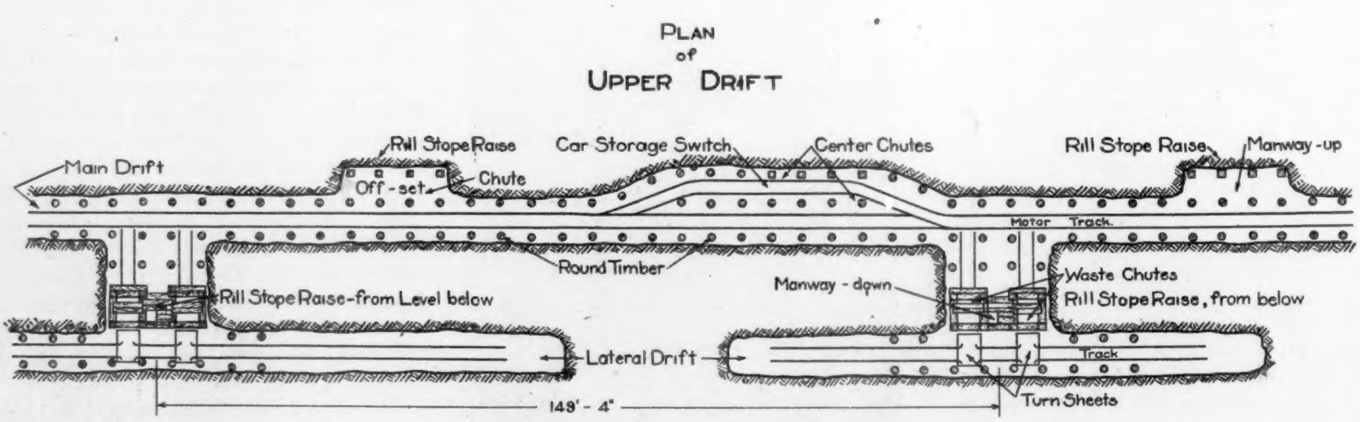


Fig. 1-a. Showing the development of the drift for timbered rill stopes both above and below.

sets on each floor so that it is only necessary to mine one set on the seventh floor. This gives the stope an angle very nearly the same as that taken by the waste pile when the filling is poured in later down the chute of the rill stope raise.

The ore broken above the second floor can be carried down to the second floor by means of small temporary slides. If there is waste in the ore, it can be picked out and thrown down on the sheeting timbers over the drift. This waste should be thrown into the gob as near as possible to the rill stope raise end of the stope. The temporary slides can sometimes be arranged so that the ore can be shovelled directly into the center chute, but when working at the end toward the rill stope raise it is necessary to tram to the center chute by means of wheelbarrows.

When the fifth floor of the stope has been connected to the rill stope raise, the waste picked from the sorting chutes is also thrown into the stope until the raise is finished and the chute emptied of the waste which it is

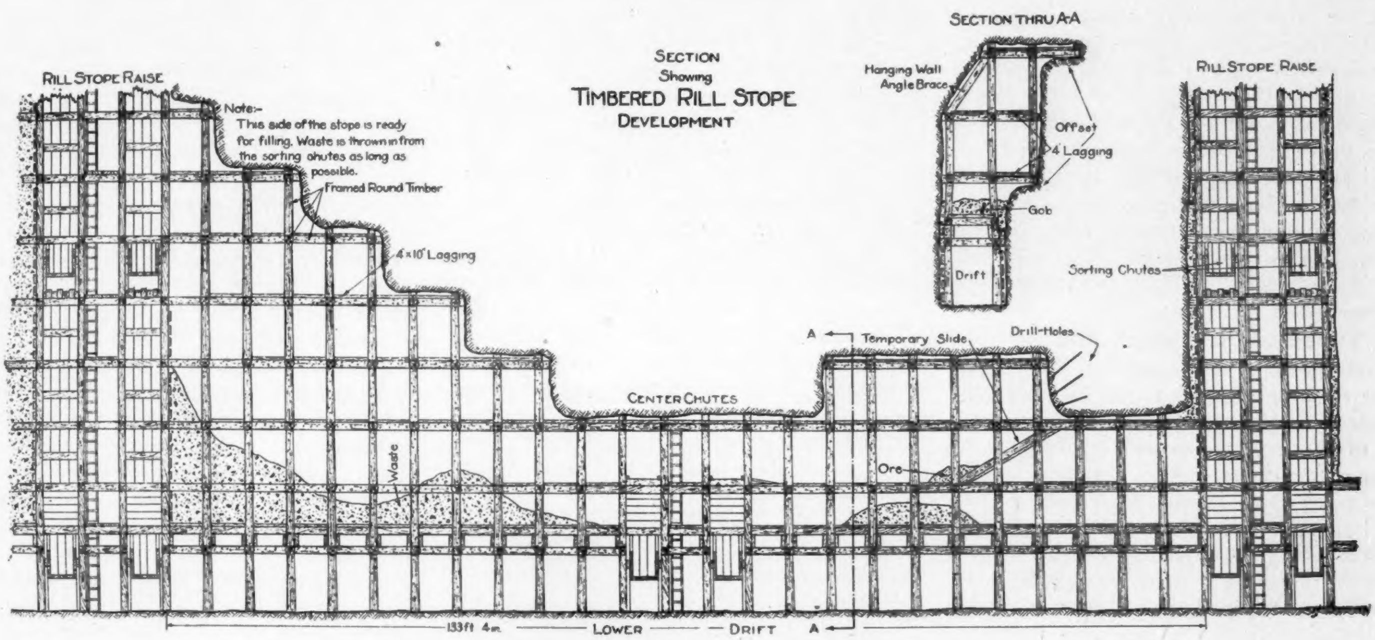


Fig. 2. Preliminary development of a timbered rill stope.

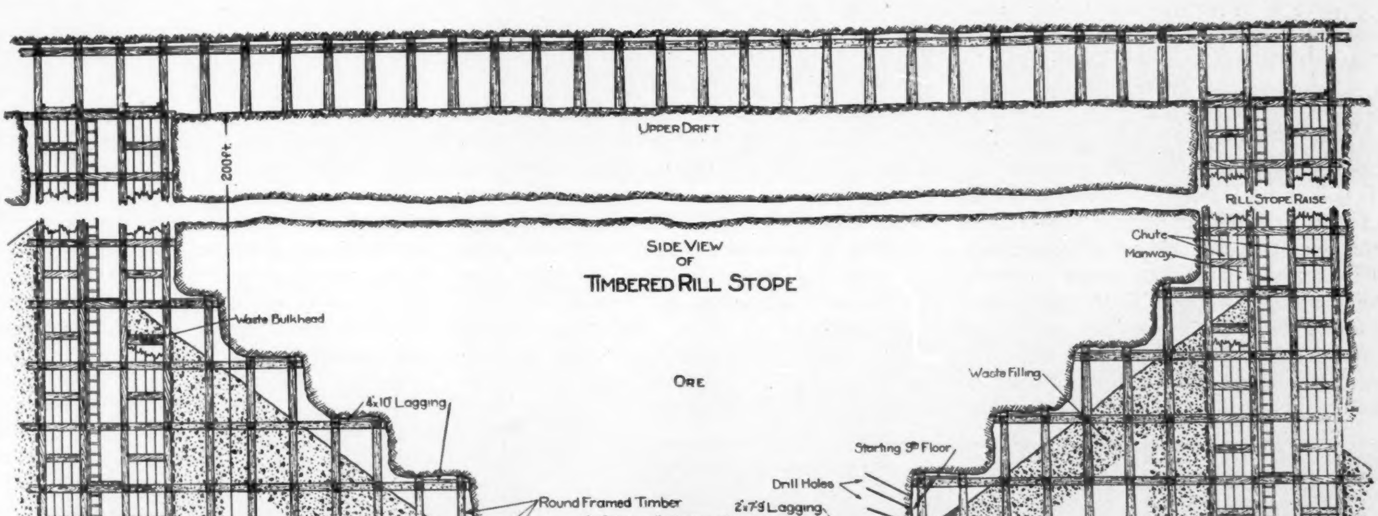


Fig. 4. Timbered rill stope after development and as carried up toward upper level.

necessary to break in order to hole the raise to the upper level. The stope on each side of the center chutes is developed in this way. When the raises are finished and the raise chutes cleaned of waste, bulkheads are built in the two rill stope raise chutes, nearest the stopes, just above the caps of the seventh floor. This gives a free opening into the stope and will leave plenty of room for mining after the stope has been filled with waste. All the lagging in the stope is then removed from each floor and piled in the set, on that floor, nearest the center chutes. The waste can be dumped into the top of the bulkheaded chute on the level above and the stope filled. As in an open rill stope the waste pile will make an inclined surface in the stope conforming closely to the general angle of rise in the timbers leaving usually a set or two open on each floor. The filling completes the development of the stopes.

Timbered Rill Stope Mining

Development is now complete. Both sides of the rill have been filled and the waste pile extends from the hole in the chute near the peak of the stope on an incline down to the grizzly of the center chutes.

The miners build a slide composed of two-inch lagging varying in width from eight inches to twelve inches on top of the waste pile and extending up the stope about three sets and also a grizzly over the chute next to the stope being mined. The mining is then begun. Starting on the third floor the ore is mined up to and across the center chutes, putting in square set timber after each blast. The ore is blasted down on the slide, which was previously built and slides down to the chute. Round timber is used for the square sets in the stope and square 10x10-inch timber for the sets put in the center raise.

When the third floor is finished, a set of slide is laid on the waste, and mining is started on the fourth floor advancing it four sets so that the last two posts will be of square timber and directly over the first square timber on the floor below. The fifth, sixth and seventh floors are advanced in the same way, the eighth floor is started from the rill stope raise and advanced three sets and ninth floor one set. As the mining progresses up the stope the ore slide is laid on the waste pile each time, so that it will catch all ore blasted.

The ore broken in the stope runs down the ore slide to the grizzly and is sorted, if necessary, and run down the chute. The waste is picked from the top of the grizzly and thrown into the other chute of the center raise. This waste rock can be drawn into cars by the train crew and dumped down the filling chutes to the stopes of the level below. One of the miners can run the ore through the grizzly while his partner is drilling.

Timber for the stope is lowered down the rill stope raise from the level above, doing away with the slow and costly work of hoisting.

The above constitutes a "cut" of the stope. After all the ore has been run into the ore chute, the ore slide is removed from the waste incline, and piled in a convenient place. The stope sides of both the center raise and the rill stope raise are gobbed with two-inch lagging, the waste chute of the rill stope raise is bulkheaded on the eighth floor and the stope can be again filled with waste. While this is being done the miners take a cut from the other stope across the center raise bringing both sides up to the same level at the top and bottom. These operations are repeated, taking a cut from one stope and then the other and advancing the whole stope up toward the level above.

When the peaks of both stopes have reached to within five floors of the level above, the "V" part of the stope is mined only, until the stope is leveled to one floor, filling is put in close to this floor and the stope left until the time when it is possible to mine the last five floors holing the upper drift.

Methods for Filling Stopes

As timbered rill stopes must be filled after each cut is taken from the center chutes to the peak, the question of supplying the waste in amounts sufficient to keep all of the stopes working at once presents itself. At the mine in which the writer had had his experience this question was solved in a very efficient way.

A system of rill stopes was started on the new levels, the distance from center to center of the rill stope raises being very close to 150 ft. Above one particular level there were ten of these stopes, the one nearest the shaft being the oldest and highest and the intermediate stopes being gradually lower until the last one which was farthest from the shaft and the lowest. For these stopes it was necessary to drive eleven rill stope raises, 150 ft. apart and all holing on the level above, in the hanging wall as described previously. See Fig. 1.

As the stopes are advanced up under the upper drift, the shock due to blasting tends to weaken the floor of the upper drift causing it to sink in places. This causes the grade of the track to vary some times to such a degree that it is very difficult to keep it in good condition for the motor. For this reason it is the best practice to start as soon as possible, after the first rill stope raises have been finished, to drive a lateral drift or haulage way, parallel to the main drift and at a distance of from 15 ft. to 20 ft. into the hanging wall from the hanging wall posts of the drift.

This lateral is driven in the solid rock and usually requires very little timbering. In most places no timber is used except that necessary to suspend the trolley wire for the motor. Owing to the rill stope raises being holed in the hanging wall of the upper drift it is possible to start sections of the lateral drift going both ways from the top of each raise. See Fig. 1-A. Two crews of drift men were kept at work in the lateral. They worked in the sections of the lateral at the tops of raises where waste was needed and all waste broken in the mining of the laterals was trammed to the proper chutes of the raises and dumped down into the stopes. This proved to be a very efficient and economical way of filling the stopes, especially as it was necessary to drive the lateral drifts in any case. All of the rock broken in them was used at a very small tramming cost.

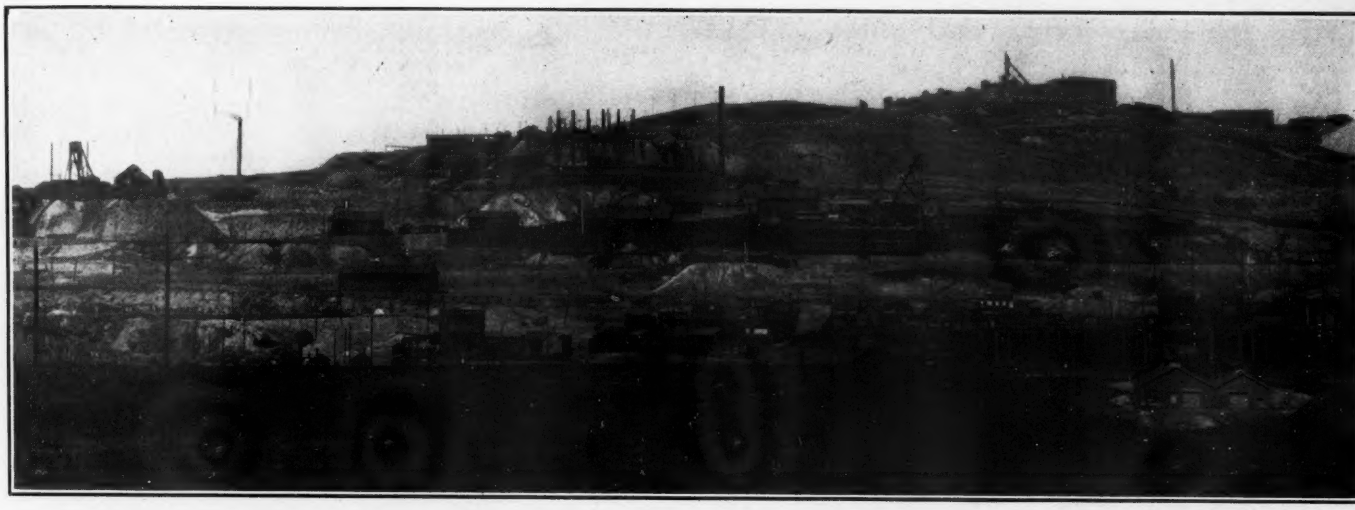
Of course the waste broken in the driving of the lateral was not sufficient to completely fill the stopes below. The rest of the waste filling necesary was either taken from the chutes on the upper level or transferred from some other part of the mine in the main shaft and hauled in and dumped into the proper chutes.

On account of the fact that the vein in which this mining was done, is composed of lenticular shaped ore bodies which vary from a few inches of ore up to a vein width of ten feet to twelve feet or more, it is sometimes possible to vary the stopes in the same vein, using the open rill type where the vein is narrow and the walls and ore body fairly firm, and in the wider portion of the vein using the timbered rill system. It happened in several instances that one side of a rill stope, including the ore between two adjacent rill stope raises was mined by the open rill method and the half of the stope on the other side of the center chutes was mined using the timbered rill method, due to the fact that the vein on the latter side was much wider and harder to hold without using timber.

Stopes have also been started as open rills and mined as such for several floors, when it was found that the ore was widening out and that it was necessary to change the mining

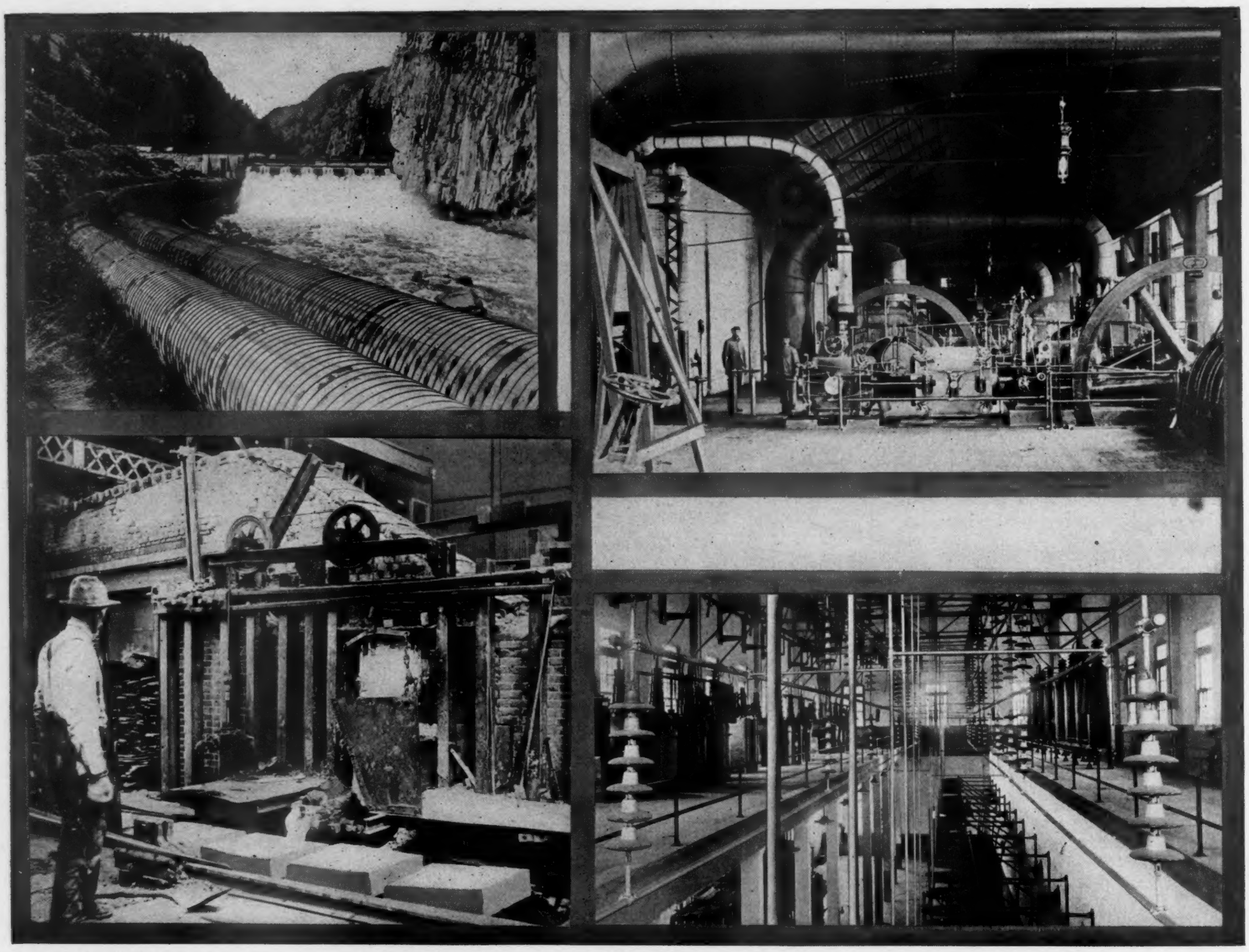
Hydrostatic pressure tank used for controlling air pressures in the storage system at Butte. When the constant pressure in the receivers falls, pressure is supplied from the receiving space under these tanks of water.

The zinc concentrating mill of the Butte & Superior Company.



East slope of Anaconda hill looking in a westerly direction.

View showing the famous "Tin Can Smelter" or copper precipitation tanks, where the green copper water pumped from the mines is circulated through piles of pieces of old iron. The copper is precipitated on the iron and later recovered and sent to the smelter. In former days tin cans were used instead of iron scrap. The man in the view is sweeping the copper from the iron scrap. In the distance is the range mountains caused by the continental fault. Little or no copper is found to the east of this immense fault.



Upper left—Madison River dam, No. 2, and 10 ft. and 12 ft. wood stave pipe carrying water supply to power house for transformation to electric power. Upper right—A few of the big air compressors in the plant at the Washoe Reduction Works at Anaconda, Montana. Lower left—Casting machine, Washoe Reduction Works. Lower right—Interior of the Rainbow sub-station, Butte, Mont.

method to that of the timbered rill type. To make this change, it is a simple matter of laying timber on the waste incline as the mining progresses gradually changing over from the open to the timbered rill stope. These instances merely show the flexibility of the rill system of stoping and the convenient way that it can be adapted to the varying of width of the vein and the strength of the walls.

Drilling Rill Stopes

For drilling in these timbered rill stopes the Ingersoll-Rand CC-11 and CC-21 dry stopehamers have been used in the past few years. These two drills, known by the miners as "stopers" or "buzzies," on account of the speed of rotation of the hammer and the resulting great number of blows per minute, are of the same general type. The CC-11 has the same cylinder, but a stroke of an inch less than the heavier, slower and more powerful hitting CC-21. The Waugh and Sullivan companies stoping drills are also used to some extent in the mines. Nearly all of this type of drills are equipped with anvil block chucks in order to prevent the drill steel from falling back into the hammer cylinder, and injuring the hammer.

In some timbered rill stopes where the ground is hard and tough, mounted rock drills of the drifter type are used for drilling. Of this type the Ingersoll-Rand No. 248, the Waugh Turbro, Nos. 60 and 66, and the Sullivan DR-6 have been used. In case mounted drills are used the round is drilled somewhat differently as the ground is usually harder than where stopers are used.

Wet stoping drills are coming to be preferred especially in stopes where the ore is fairly hard causing considerable dust when being drilled by dry machines. The new type of wet or water stopers is being equipped with self rotating devices and in some cases, with air feed controls. This does away with "twisting the buzzie's tail" as the miners call hand rotation of the drill, and allows the miner to control the speed of the drilling by simply pressing a button on the handle of the drill and by varying the pressure on the button he can raise the air feed more slowly or hold the drill suspended on the air feed while freeing the drill in case of fitchery ground. The added "boon" of water going through the hollow drill not only washes out the cuttings in the holes but absolutely stops all dust and by adjusting the amount of water fed through the water needle and blown through the drill the dripping of water on the miner is reduced to a minimum.

The drill itself due to a steady positive rotation keeps the drill hole round and uniform in size and the instantaneous control of the air feed prevents the drill from racing into pockets of soft ground, sticking the drill and usually causing severe strains on the rotation parts.

Some miners will object at first to the mixed dust and water, more or less of which is usually splashed on them especially when drilling straight or nearly straight upper holes, but when it is realized by them that the slight inconvenience caused by this not only prevents the miners pthysis or miners consumption, these wet drills should become very popular.

Minor repairs on drills, such as the replacing of worn or broken water needles, nuts, lock washers and side rod springs are taken care of in the mine. For general overhauling and cleaning however they are sent to the surface shop maintained for that purpose.

The steel used in wet stoping drills will be hollow steel of hexagon section. The mining companies have been experimenting with this and other sections and it is expected that the hollow hexagon steel, shankless, without lugs or collars, and of ⅞ in. or 1 in. diameter will be used most generally.

The four point straight face cross bit, with

⅛ in. change in gage and 12 in. or 18 in. run is most generally used in the Butte district. Great care is taken to insure properly formed and correctly gaged bits and proper shank ends on the steels. Bits and shanks are made and resharpened on air operated sharpeners, the larger percentage being done on the Ingersoll-Rand Sharpeners Types No. 5 or No. 50. The bits are plunge tempered in cold water and the shanks are plunged in some soluble oil.

Drilling in a Timbered Rill Stope

The following data illustrating the drilling of timbered rill stopes are taken from the actual weekly run of an average stope. The time allowed for the drilling, timbering and mucking and barring down was estimated by a number of men who had been in charge of this work for some time and in a number of similar stopes.

The time allowed for drilling includes the time necessary to set up the machine, connect the hose, actual drilling, freeing any stuck drills, changing drills and moving from one "set up" to another. It is the total time spent by the man or men, in drilling during the shift.

This stope is two sets wide, averaging 12 ft. from foot wall to hanging wall. The ore is a mixture of primary and secondary chalcocite with pyrite, with stringers of granite running through it in places. The time allowed for mucking includes barring down, pulling the ore down the slide to the chute, when necessary and sorting the ore on the grizzly. There were three men per shift in the stope, working two shifts (day and night) of eight hours per 24 hours and for six days. Ingersoll-Rand CC-21 dry Stopehamers were used for drilling. These drills used 1¼-in. solid cruciform steel with double tapered four point straight face cross bits. Change in gage ⅛-in. and run of steel eighteen inches.

By "drilling time" is meant the total time required to set up the drill, connect air hose, etc., drilling, changing steel and removing any stuck steels.

BEARING METALS

Experimental work on determining the compression and hardness values of white metal bearing alloys at temperatures up to 100° C., has been completed according to the *Scientific American*. A paper has been prepared entitled "Some Properties of White Metal Bearing Alloys at Elevated Temperatures," a summary of which is as follows: An apparatus is described for determining the yield point and ultimate strength of white metal bearing alloys at temperatures up to 100° C. A new design of heating apparatus is described for determining the Brinell hardness of such metals in the range of temperatures indicated above. The results of compression tests and Brinell hardness tests at temperatures up to 100° C. are given for five typical white metal bearing alloys, including three tin base alloys, one lead base alloy, and one intermediate alloy. These tests showed that the tin base alloys maintain their properties better at elevated temperatures than those containing lead. Results of tests are given which indicate that up to three per cent. the lead in a high grade babbitt does not affect the yield point or ultimate strength at 25° C. or 75° C. Tests are described which show that the yield point of tin base alloy is not affected by heating for six weeks at about 100° C., but that the yield point is lowered in the lead base alloy by heating for only two weeks at this temperature.

For estimating purposes in computing heating values, the following average figures should be used:

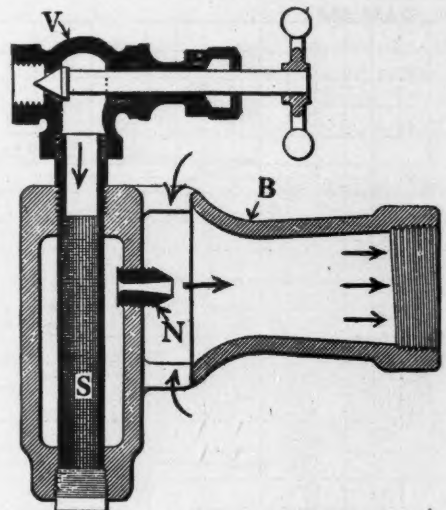
Producer Gas	150 B.T.U. per cu. ft.
Coal Gas	600 B.T.U. per cu. ft.
Coke Oven Gas	550 B.T.U. per cu. ft.
Natural Gas	1,100 B.T.U. per cu. ft.
Fuel Oil	125,000 B.T.U. per cu. ft.

A slate quarry recently opened up at Bullengarook, Victoria, is said to be maintaining an output of 6,000 school slates per week. American scholars of the present day would not know what to do with 'em.

BLOWER WHICH EXCHANGES PRESSURE FOR VOLUME

THE ACCOMPANYING illustration shows a blower whose purpose is the transforming of a small volume of high pressure air to a much larger volume of low pressure air such as may be used for the operating of rivet forges and similar equipment.

Referring to the cut, *B* is a blast tube with a thread for attaching to the forge or other apparatus, and *N* is the high pressure jet nozzle with an orifice of proper size and shape. *S* is a strainer which prevents dirt and other foreign material from choking up the small orifice in the jet nozzle. This strainer may be cleaned by removing the bottom plug and blowing air through it. *V* is the needle valve which regulates the blast and to which the air hose is connected.



Blower exchanges pressure for volume.

In operation the compressed air issues from the jet nozzle at high velocity and the energy resulting from its velocity is imparted to the surrounding air which passes forward into the throat of the blast tube. This air is replaced constantly by additional air flowing in at the side openings of the blast tube. The standard blower will deliver air up to four inches water pressure, although higher pressure may be obtained with special jet nozzles. The new device is manufactured by the New Jersey Meter Co., Plainfield, N. J.

SIFTING THE NAMES OF ROCKS

A committee of the Geological Society and the Mineralogical Society appointed to consider the standardization of British petrographic nomenclature has recently reported its recommendations. No names of general undisputed definitions are discussed and only British names appear. Forty-seven terms naming rock species or textures are given preferred definitions; twenty-seven terms are classed as obsolete or unnecessary, being used in more than one sense, and their further use is condemned. In this list one notes "diabase," "binary granite," and "melaphyre." A list of synonyms indicates the committee's preference for nineteen terms which have simplicity or priority in their favor.

DRILL DATA

No. of holes drilled per set	5
Depth of holes, average	8 feet
No. of shifts worked by the men in six days	36
Price paid per shift to each man	$7.1916
No. of sets completed in six days	15
Tons of ore delivered to chute	431.5
No. of shifts worked per set of ground completed, includes drilling, timbering and mucking, $\frac{\text{36 shifts}}{\text{15 sets}}$	2.4
No. of hours worked per set	19.2
Estimate of labor as follows:	
Drilling 3 hours 30 min.	
Timbering 11 " 0 "	
Mucking 4 " 42 "	
Total 19 hours 12 min.	
Distance drilled per set—five holes—8 ft. long	40 feet
Inches drilled in 3½ hours	480
Inches drilled per minute $\frac{480}{210}$ =	2.285
Time drilled per shift—three men—eight hours each	4 hrs. 23 m.
Distance drilled in 4 hrs. 23 min. =	601.14 inches
Distance drilled per shift in feet	50 feet 1 inch
Cost of drilling for one shift = $\frac{\$7.1916}{\text{263 minutes}}$	$2.734
Ore broken per shift = $\frac{431.5}{12}$ =	35.95 tons
Drilling cost per ton = $\frac{2.734}{35.95}$	7.6 cents

THE EDISON ROOMFUL OF AIR

By FRANK RICHARDS

IN THE now well known list of questions used by Mr. Edison for the testing of the qualifications of candidates for employment is one which has been of special interest to me. It admits of such a range of answers, each perfectly correct and admissible under conditions which might be assumed, that I have some curiosity as to the precise answer that would have been satisfactory to Mr. Edison.

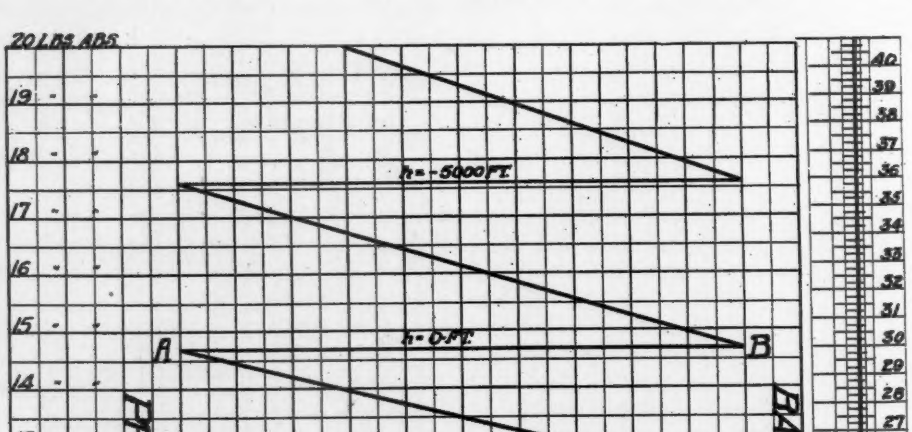
The question, as I have it, is: What is the weight of air contained in a room 20 by 30 by 10 feet? The capacity of the room thus being 6000 cu. ft., it should be only necessary to know the weight of one cubic foot of air and multiply it by this number. A cubic foot of dry air at normal atmospheric, sea level pressure (14.7 lb.) and at any absolute temperature, Fahrenheit, will weigh 39.819 lb. divided by the absolute temperature, or:

$$\frac{39.819}{(t + 461)} = W$$

t being the temperature by the thermometer and W the weight of 1 cu. ft. By this means we find that at a temperature of 60 degrees the weight of 1 cu. ft. of dry air would be .0764 lb., and the total weight of the air in the room would be 458.4 lb.; at 32 degrees the weight would be 484.6 lb., and at 100 degrees it would be 425.8 lb.

These are the greatest weights of free air which the room would be likely to contain under any practical conditions. The weight of the roomful of liquid air, by the way, would be more than 180 tons. If the room were located above sea level the weight of the air content would be proportionately less according to the reduced atmospheric pressure of the locality. Thus, to assume an extreme case, if the room were located at an altitude of 15,000 feet, where not many rooms are to be found, the normal atmospheric pressure would be 8.29 lb., absolute. Then the weight of the roomful of air would be: at 32 degrees, 274.56 lb.; at 60 degrees, 258.65 lb. and at 100 degrees; 240.21 lb.

Fig. 1 has been plotted by Mr. F. W. O'Neil to show at a glance the normal atmospheric pressure (absolute) at different altitudes, the reading at the left being in pounds per square inch and at the right in inches of mercury. The oblique lines, it will be observed, are successive portions of a continuous curve, one beginning to rise at the right hand as the preceding one terminates at the left. The entire curve is shown as a continuous line in Fig. 2, but drawn to a smaller scale.



By Courtesy F. W. O'Neil.

Fig. 1. Absolute atmospheric pressures at different altitudes.

Fig. 2. Continuous curve of atmospheric pressures.

FIRST SHIP IS SALVAGED FROM CAPE SABLE ROCK

FOR THE FIRST TIME in maritime history a ship has been plucked from the grasp of Blonde Rock, on Cape Sable, Nova Scotia, says the *Nautical Gazette*. This reef has been a notorious menace to shipping, and many ships and lives have been lost in the vicinity, the most noted wreck being that of the Allan liner *Hungarian* 63 years ago, when 400 lives were lost. A few weeks ago the Imperial Oil Company's steamer *Impoco* of 2,257 gross tons stranded there, and was generally given up as lost; but by the resourcefulness of the Maritime Wrecking Company she has now been salvaged and towed to harbor.

Owing to the shallow water and heavy seas, the salvage steamer had to lie some distance off. A 6-in. armored hose was conveyed to the *Impoco* through which air was forced into a pipe line on the deck of the wreck with connections and controlling valves leading to fifteen sealed compartments. Compressed air was then driven into the ship, which forced the water in her hold through the holes in her bottom until she gradually lifted off the ledge. It was impossible to do anything with the engine or pump rooms, which carried 850 tons of water, so that she came off with her nose in the air and her stern awash and was towed in this manner for seventeen miles.

A Swedish artillery regiment has carried out some interesting tests in order to investigate the use of ball bearings in heavy horse-drawn army vehicles. It was found that the ball bearings reduced the tractive resistance by at least 30 per cent., and the experiment shows the possibility of reducing proportionately the number of horses to each vehicle.

A Pneumatically Operated Plant for Salvaging Grain*

CONSIDERABLE DESCRIPTION of a technical nature has appeared relative to the pneumatic conveyance equipment of the Guarantee Construction Co. Each of their many installations is a job in itself and is built specifically to the demands of the case and the needs of the operator. Elevators, mills, cereal plants, feed manufacturing properties, etc., are using this pneumatic equipment adapted successfully to their several individual needs. The adaptation of this conveyor to the peculiar conditions created by the explosion of the C. & N. W. Elevator, operated by the Armour Grain Co., heretofore made familiar to our readers, is typical of the great adaptability of the conveyor to unusual circumstances and the easy installation of the Airveyor Equipment. "Airveyor Equipment," by the way, is the name given the outfit and the system by the manufacturers, the Guarantee Construction Co., of 140 Cedar Street, New York City.

Without repeating the early experience of those handling grain materials pneumatically or pointing out the progressive use of the pneumatic system abroad for handling grain, where it has been standard for so many years, both in England and on the Continent, we will give a brief description of the present installation used in cleaning up and salvaging grain at the Armour Elevator referred to.

Our readers will recall reading of the explosion's disastrous effects on a standard concrete and steel structure, and probably there has been no similar loss or engineering project in this field so widely commented upon. Therefore, in making ready for the new house, contract for whose designing has been awarded to John S. Metcalf Co. of Chicago, while the erection work and all that goes with it will be done by the Witherspoon-Englar Co. of Chicago, we shall treat of the big item in construction news by showing the steps being taken to clean away the debris of the old house in which many millions of bushels of grain were stored at the time of the explosion.

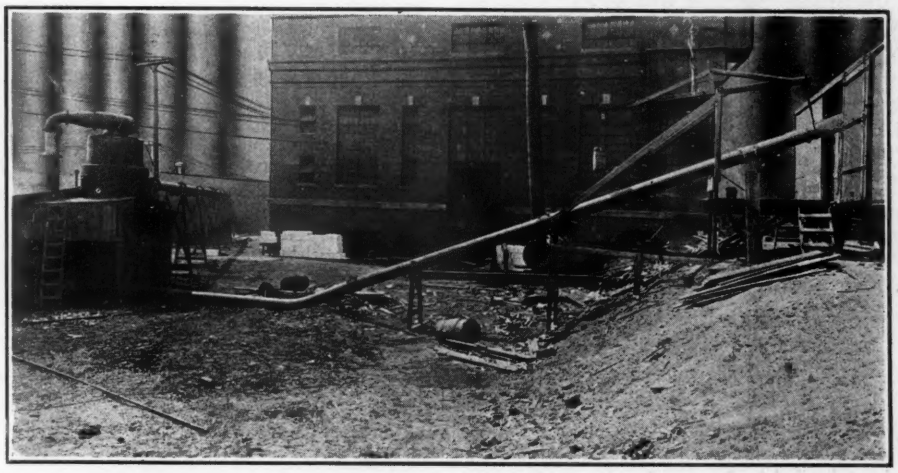
Entire blocks of concrete storage tanks, if not entirely demolished, had been moved on their foundations. The marine leg on the Calumet River side had been lifted entirely off its foundation and set down standing vertically in the river itself—fortunately in the water just off the dock instead of being thrown across the river, and therefore transportation was not blocked. This is one of the hundreds of unusual features of this house which have nonplussed engineers; and there are so many unusual circumstances in this connection that it seems today that the cause of the fire and explosion will never be cleared up.

At the time of the fire and explosion the elevator contained approximately six million bushels of grain, most of which was damaged and exposed to the weather by the catastrophe. The salvage grain is being handled for the insurance companies by the Armour Grain Co., who have employed C. W. Austin of the Chicago Grain and Salvage Co., to take charge of the recovery of the grain and all salvage operations at the elevator.

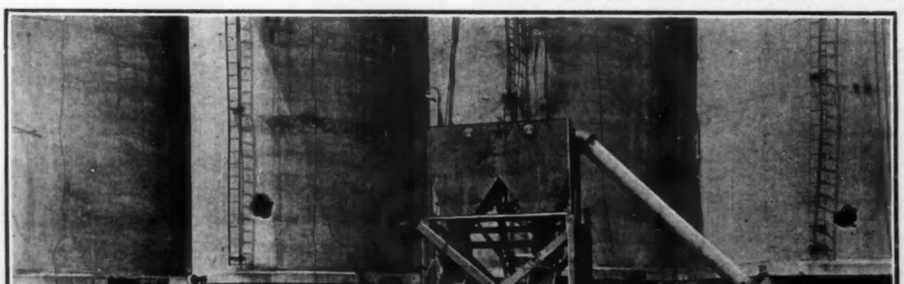
The first work necessary was to clear away wreckage to recover the bodies of the men killed, and to make it safe for men to work. The John K. Thompson Company with a large force of men were engaged several weeks in this work and in erecting such machinery as could be used to get the grain out. One track was laid through the west bay of the work house and another in the field south of the elevator, from main line to the pile of wrecked bins at the southeast corner of the storage house, and power to operate several farmers' loaders was obtained by bringing a wire from the Chicago and North Western round house.

With these loaders and a force of trucks and teams from the Davison Cartage Co., loading was started on March 29th and about 600 cars were loaded before full power was available. Meantime repair work on the power house and two legs in north end of work house were started and full power was ready on May 13, and the two legs and belts feeding them from the storage were started. In the south part of the work house the legs were too badly damaged to be readily repaired, so four Bernert Blowers were installed to take grain from bins in south side of storage and load it into cars on the tracks in the field.

As soon as the power house of the plant was put in shape and ample power provided for all needs, two separate Airveyor Equipments were installed, one of which with 2,400 bushels capacity per hour is located on the river side. This removes grain from the river house direct into boats. The other equipment rigging is set 300 feet from the main storage tanks (in



Grain being loaded by pneumatic conveyor into freight cars. In the background is shown the grain elevators.



Pneumatically recovered grain being loaded into a cargo ship.

*Reprinted from "The Price Current—Grain Reporter."

pneumatic conveyance such distances are no drawbacks to the efficient operation of the equipment), which handles 4,000 bushels per hour and removes grain from the storage bins direct into cars. The inlet of these suction leads is in the bottom of the bins where only one man is required to shift the nozzles from time to time, but in the Armour job one is used more particularly to manually throw out pieces of concrete, steel and other debris found in the grain being moved.

The engineers of the Guarantee Construction Co. say in this connection that a piece of concrete weighing eighteen pounds was taken through their leads and carried into the receiving tank. This later device is an interesting trouble-preventer in the pneumatic system. It takes all of the materials carried in suction through the leads and through the installation of a balanced screen within the tank foreign materials which would tend to clog up the machine, collect on this screen, and automatically stop operations. The pipe leads carrying out of this receiving tank operate on pressure and, as so often explained herein, the combination of suction and pressure conveyance of air in which the grain is carried provides a simple but effective means of loading and unloading cars, boats and barges.

The rig on the land side of the elevator loaded grain direct into cars at the rate of 33 minutes to the car, filling each by the way clear up to the roof, with no losses of grain and requiring only one man at the loading end.

On the south side of the demolished tanks of the elevator a great gang of workmen has been working for weeks and it was estimated they would continue to do so for several months more, removing the grain and the debris of the demolished structure.

Up to May 26 about 270,000 bushels of oats had been loaded by boat and 920 cars of other grain of various kinds moved. The basement is still all filled with grain and as that is cleared out and bins are emptied, the blowers and belts are extended further under the storage.

Work is proceeding fairly well, but considerable trouble and delay is and will be caused by concrete blocking the bin outlets. Loadings now average about 40 cars per day, but these will be increased considerably unless unforeseen difficulties occur.

The John S. Metcalf Co., in speaking of the designing and developing reconstruction of the elevator, are at this early date unable to specifically discuss the details. However, they advise that the plant will be rebuilt on practically the same lines as before with certain notable improvements, however, as follows: The drier house, in which the drying capacity will be rebuilt more substantially, with the same tonnage as in the original house, will however be built separately from the work house. Its removal from the work house proper is the change in design which it is felt will tend towards better operation. The dust collecting and ventilating features of the new structure, which will soon be under way, will embody many changes and improvements.

An expenditure of more money possibly along this line seems justified, as the first precaution against further disaster through explosions and fire. Machinery materials and the thousand and one buying problems in the new house have not been settled, although such purchases are now being arranged, including Fenestra window walls, used in the old house, the advantages of which in elevator and mill construction are indisputable.

The Metcalf Co. indicate that every known improvement in the mechanical design of a perfect elevator enter into the new work which will be a monument to the engineers, to the contractors, the Witherspoon-Englar Co., to the owners, the Chicago & North Western Railroad, and the operators, the Armour Grain Co.

Some General Remarks

One of the difficulties encountered in standardizing the pneumatic conveyance of grain in certain markets has been the traditional policy of insisting upon retaining all of the dust originally in the grain.

The saving of the weight and bushelage in the dust in a car or in a boat is quite likely lost 1,000 times over in these dust explosions. There is furthermore to be reckoned with the loss of life, with possible closer supervision by insurance interests of the milling, feed, seed and grain elevators, subject to explosive losses.

Airveyor Equipment, however, includes dust collectors with each unit so that all dust having commercial value may be collected and discharged if desired with the grain. The manufacturers outline no procedure to the owners of their equipment, but they simply make it possible to retain all dust separately from the grain for remixing it if desired.

They do urge, however, that the lighter materials in dust collection should be destroyed, containing as they do no feed value. This thought is certainly deserving of recognition by the trade whose members are surely not knowingly continuing a practice so unnecessary from an engineering point of view and so disastrous in its consequences by insisting upon retaining dust in the original grain in every process.

HIGHEST AND LOWEST LAND

The difference between the highest and the lowest points of land in the United States is 14,777 feet, according to the United States Geological Survey, Department of the Interior. Mount Whitney, the highest point, is 14,501 feet above sea level, and in Death Valley there is a depression that lies 276 feet below sea level. These two points, which are both in California, are less than 90 miles apart. This difference in height is small, however, as compared with the difference in the height and depth of land in Asia. Mount Everest rises 29,002 feet above sea level, whereas the shores of the Dead Sea lie 1,290 feet below sea level, a total difference in height of 30,292 feet.

A bridge is to be built across San Francisco Bay, the money being subscribed and the plans completed. It will be more than eight miles long, 200 feet wide, and, besides providing for traffic of all kinds, will carry oil, gas and water pipes and electric conduits for the public utility companies.

GUNITE IN CALUMET AND HECLA SHAFTS*

By JOHN KNOX AND OCHA POTTER

THE CALUMET & HECLA conglomerate has been mined very largely through inclined shifts, the inclination being from 35 degrees to 40 degrees. From time to time some of the intermediate shafts were abandoned until at present there are only five remaining in active use. But these have reached depths so great—8,000 feet and more—that it is economically impracticable to maintain them in working condition.

The enormous area stoped out—one and one-half miles deep by two and one-half miles in length—has started movement so vast that no attempts are made to do more than provide temporary checks here and there to maintain passage ways in the form of drifts and shafts.

The Constant Squeeze

The heaviest concrete and masonry crumble as so much clay, and massive steel sets are twisted and torn. Rock and timber cribbing squeeze together in time, and openings in parts of the conglomerate close up to such an extent that after a few years they must sometimes be redrifted in order to be available as passage ways.

Occasional so-called "air blasts" occur and sometimes hundreds of tons of rock are thrown violently from the apparently solid sides of shaft or drift. These phenomena are accompanied by terrific gun-like reports and at times have broken twelve-inch air mains, torn up tracks, and even filled several hundred feet of shaft or drift with debris.

It was, therefore, decided to cut off all incline shafts at the 81st level—about 8100 feet from surface on the incline—and to practically duplicate the surface layout of a mine at this depth with the exception of rock crushers and air compressors. It is planned to erect hoisting engines capable of hoisting from an additional depth of three thousand feet, and to operate an electric railway whose main line will be over three miles in length.

Shortly after driving of the main tunnel had started, we were much disturbed by the fact that "slabbing" began on a very extensive scale. There were no "air blasts" and no big caves, but ground that had been carefully barred for loose would again become dangerous, frequently in a few days. This finally became so serious that it was realized that the expense of timbering, with the probable continuous upkeep cost, might jeopardize the success of the entire plan.

At some time previous to this our attention had been called to some very successful experiments which had been conducted by certain coal mines where "slabbing" of the roof had been overcome by the use of "gunite." It was, therefore, decided that gunite would be tried, and in February, 1919, several hundred feet of tunnel were "gunned." Much to our gratification, "slabbing" stopped at once and the cement remained unbroken.

It did not seem possible that a quarter to a half inch of cement and sand would have

*Abstracted from "M. C. M. Alumnus."

Before Gunning.

a very lasting effect, and so no more "gunning" was done for a couple of months, in order to give time for something to develop. The only thing that hapened, however, was that due to the gunite being put on all in one coat, it was a little too thick in spots and before the cement had time to set properly, the weight of the material itself pulled the gunite away from the rock leaving occasional air spaces. This formed a sort of blister which finally resulted in small slabs of cement falling off and again letting the air and moisture reach the rock.

In later work this difficulty has been entirely overcome by putting on two very thin coats —usually one coat on one shift followed by another coat on the succeeding shift.

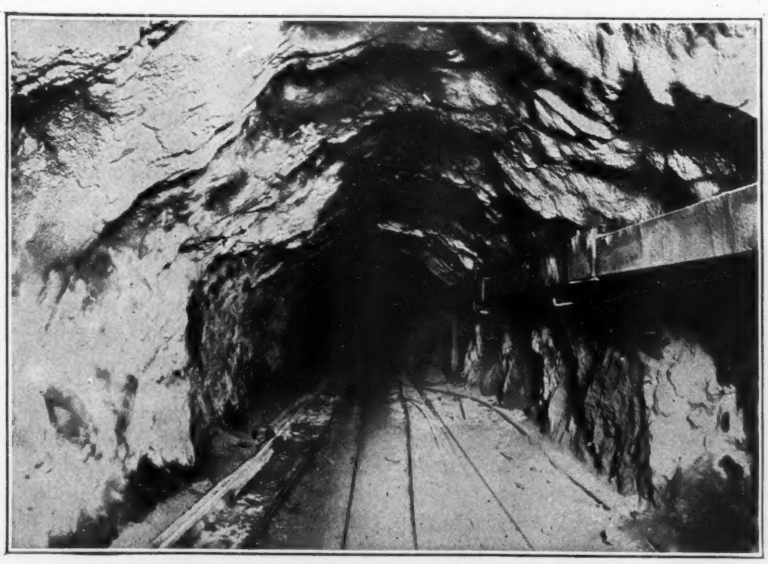
Up to December 4th, 1920, 8,772 feet have been "gunned" and there is not a stick of timber being used in any part of this completed portion for the purpose of supporting loose ground. Nor are there any cracks showing which would indicate that we may expect any difficulty in the future from this source.

The most skeptical of us have become enthusiasts in the use of gunite under these conditions and it is scarcely too much to say that the entire project might easily have become endangered were it not for the success that has attended its use.

It is not, however, proof against severe "air blasts." A series of very severe "blasts" last spring loosened and cracked portions of the gunite for several hundred feet and it was necessary to trim and "gun" this area again. There was no question as to the cause of the trouble, however, and the expense of repair was very small compared to the cost of repairing a timbered drift under similar conditions.

About a year ago a section of the No. 4 shaft of the North Kearsarge mine was giving a great deal of trouble due to "slabbing." As an experiment, this section was carefully "gunned" and to date has required no further attention.

At the present writing two conclusions seem obvious—1st, that the cause of a great deal of the "slabbing" or caving of the walls of our shafts and other openings is not thoroughly understood; and—2nd, that "gunning" is certainly a very effective and relatively inexpensive retardant for many of these disturbances.



After Gunning.

Notes

The gunite mixture used consisted of two and one-half parts of sand to one of cement.

The sand was screened through a three sixteenths inch mesh.

Air pressure used was 65 pounds.

Water pressure, 40-50 pounds.

Gun used was manufactured by Cement Gun Company of Cornwells, Pennsylvania.

There were four men used each shift on "gun" work—two charging the gun and two men who alternated at the nozzle. These men did their own barring and trimming and applied one coat of gunite over a length of 50 ft. of nine by twelve foot tunnel—or an average of six and one-half lineal feet per man per shift for a double coat.

The average thickness of one coat varies from one-eighth inch to one-fourth inch on a smooth rock surface. For two coats the thickness is from one-fourth to three-eighths inch. Crevices and hollow spots are, of course, filled and here the thickness of coat varies a great deal.

About 28,000 pounds of gunite mixture are used to complete 100 feet of tunnel.

Approximately twenty per cent. of the sand rebounded from the rock and fell to the floor. This is, of course, wasted.

Wire mesh re-enforcing was tried at first but was very expensive, difficult to apply, wasteful of gunite, and finally found to be entirely unnecessary.

It proved convenient to dry and mix the sand and cement on surface and to bring it to the operators in packages, each of which contained a full charge for the gun. However, when this plan was followed, it became necessary to add a very small quantity of water when mixing in order to prevent a separation of sand and cement during transit.

AEROPLANES TO PROSPECT FOR OIL

Prospecting for oil by aeroplane in the uncharted wilderness which constitutes the delta of the Orinoco is about to be carried out for the British controlled oilfields, according to a report just published. The company has acquired oil concessions from the Government of Venezuela in the delta of the Orinoco, a region which is largely unexplored and where the ordinary methods of prospecting would be futile. It is considered, however, that the presence of oil should easily be ascertained from the air, since where it comes to the surface vegetation cannot live. A contract for the survey has been given to the Bermuda and West Atlantic Aviation Co., Ltd. The work will be carried out with seaplanes.

The Department of Commerce, through Mr. Allport, the representative at Vienna, reports that a bill is now before the National Council proposing to extend the life of Austrian patents for six years in cases where the inventor was prevented during the war from exploiting or using his invention.

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EDITORIALS

CANNED MILK AS A MEDIUM FOR PUBLIC HEALTH

FOR MANY YEARS the public looked upon fluid milk as a food primarily for infants and invalids—something that would answer until the digestive apparatus was robust enough to deal with a more diversified diet. To-day, however, students of chemical hygiene have established beyond peradventure that milk is an "entire food" and of vital importance to the bodily well being of the human kind of all ages. Indeed, it seems that milk possesses health-building properties that make it well-nigh unique, at least in its aggregation of virtues. Therefore, the scientists, with reason, point out that everyone of us would probably be the better off if milk figured more conspicuously in our daily ration.

The average layman imagines that he has only to satisfy his appetite to meet all of the tissue-forming and heat-inducing requirements of his system. But the stomach may be filled with a measure of regularity and even the palate pleased without promoting the physiological results essential to proper nutrition and physical efficiency. In short, while eating a seeming plenty a person may steadily lose flesh, vim, and capacity to master the daily tasks, whether these be of a muscular or mental character. Finally, the condition may reach such a pass as to arouse alarm. To put it popularly, the man of research has made it clear that each one of us is, in fact, a laboratory in which chemical actions and reflexes of a complicated character are continually taking place, and that when Nature's ordered processes are interfered with we are sure to be penalized.

There was a time when scurvy menaced the mariner the world over, and not so long ago beri-beri puzzled the medical fraternity while it levied an immense toll among the peoples of the Far East especially. But it has been revealed that these diseases are due directly to malnutrition and are the immediate consequence of an unbalanced diet. Unbalanced in that the foods eaten have lacked certain properties or constituents—some of them yet invisible to the microscope but known to exist and to be indispensable to bodily well-being. And these unseen agencies that promote physical sufficiency fortunately abound in milk.

Taking us as a people, we are a pretty fine lot gauged by the standards of brawn and a general fitness to tackle the usual jobs of life. This may be explained in part by the abundance and the varied dietary we can command as a rule. According to statistics recently published by the Federal authorities, Americans consume on an average annually quite 44 gallons of milk per capita, and this may account to a good extent for our capacity for work and the widespread prevalence of a pretty high standard of health. However, there are sections where local food supplies do not promote this status, and this is notably the case where milk in plenty is not commonly available from neighboring sources.

There is a great area in the United States lying to the south of the Ohio and the Potomac Rivers where agricultural conditions have up to now not led to the forming of extensive herds of dairy cattle, and, likewise, where refrigerating facilities are frequently inadequate so that the fresh milk at hand must be used up promptly and within a short distance from the points of production. It is in this vast region that pellagra has obtained a foothold, and this malady, so the U. S. Public Health Service discloses, attacks yearly fully 100,000 persons. Of the afflicted something like five per cent succumb. Here, again, we have another example of the consequences of an unbalanced diet.

Medical research has proved that the pellagrins, well-nigh without exception, have been living upon foods deficient in vitamines, and, curiously, the daily ration has either lacked milk or milk products or the allowance of milk has been so small that the body has been denied its quota of those mysterious, wonder-working chemicals. Where milk was to be had in the needful quantity, the food otherwise being identical with that eaten by the pellagrins, dwellers in the same environment did not develop pellagra. Finally, what is still more impressive, the pellagrins could be cured and their convalescence hastened by giving them a proper daily portion of milk. In this therapeutic campaign, the experts of the U. S. Public Health Service tried milk in various forms, and found that one pound of preserved milk was just as helpful as a quart of fresh milk.

Manifestly, where the circumstances are such that fresh milk cannot be distributed freely or kept until used, then canned milk is the logical medium of relief; and the industry engaged in preserving an otherwise perishable foodstuff thus becomes an enterprise of added importance. It will probably surprise a good many of us to learn that the American manufacture of condensed milk has grown in three decades from an annual production of about 38,000,000 pounds to a present yearly output of more than 2,000,000,000 pounds! Indeed, during the ten-year period from 1909 to 1919 the business increased 410 per cent. To-day, in the United States alone, there are something like 240 plants employed in the canning of milk, and these establishments represent an outlay of many millions of dollars. Their service to the public welfare is bound to grow in significance, especially as the diet experts stand squarely behind a nation-wide propaganda to promote the daily consumption of a quart of milk.

In this movement for better general health the engineer is figuring conspicuously, because it is by means of apparatus and equipment of his devising that the raw milk can be treated and canned so that it will remain in every way fit for human use for a long while thereafter. In other words, an extremely sensitive and perishable comestible can thus be brought to a state that will permit its deliberate distribution the world over and be capable anywhere of furnishing chemical properties so vital to a continuance of health and strength. But there is an economic as well as a hygienic angle to the gains to be reaped through the conservation made possible by the milk condensery.

Let it be kept in mind that a pound of canned milk is the equivalent of two and one-half pounds of fresh milk. That is to say, the original water content of 87 per cent is reduced to approximately 30 per cent. In bulk, the finished commodity is about half that of the original raw milk from which it was made. In consequence, the canned milk weighs less and requires a smaller space while in storage or during transportation. Assuming an annual output of 2,030,000,000 pounds of concentrated milk, the extraction of water in putting up that milk leads to a saving in freight of fully 1,200,000 tons. Expressed in another way, condensing shortens the milk train by 40,000 cars! It would be impossible to state specifically the economies due to this lightening of the load, but they must be great.

The one dominant fact in the canning of milk is that this system of conserving a vital resource places at the disposal of mankind anywhere a foodstuff of incalculable value. No matter where people may be living or working it can be carried to them and used to safeguard them against the ravages of those diseases directly traceable to malnutrition.

SHAPING OUR NEW FEDERAL HIGHWAY POLICIES

THE FIRST message of President Harding to Congress contained a most pertinent and important declaration of a progressive policy of national highway construction involving participation by the national government in rendering aid to the various states. It strongly suggests a comprehensive scheme that will correlate all individual local efforts into one harmonious whole.

Some important passages in the President's statements show how the transportation problem of America depends upon these feeders to the railroads and "afford relief from local burdens." In reference to the program of projected highway construction the message reads:

"There is begun a new era in highway construction, the outlay for which runs far into hundreds of millions of dollars. Bond issues by road districts, counties, and states mount to enormous figures, and the country is facing such an outlay that it is vital that every effort shall be directed against wasted effort and unjustifiable expenditure.

The Federal Government can place no inhibition on the expenditure in the several states, but since Congress has embarked upon a policy of assisting the states in highway improvement, wisely, I believe, it can assert a wholly becoming influence in shaping policy.

With the principle of Federal participation acceptably established, probably never to be abandoned, it is important to exert Federal influence in developing comprehensive plans looking to the promotion of commerce, and apply our expenditures in the surest way to guarantee a public return for money expended.

Large Federal outlay demands a Federal voice in the program of expenditure. Congress can not justify a mere gift from the Federal purse to the several states, to be prorated among counties for road betterment. Such a course will invite abuses which it were better to guard against in the beginning.

The laws governing Federal aid should be amended and strengthened. The Federal agency of administration should be elevated to the importance and vested with authority comparable to the work before it. And Congress ought to prescribe conditions to Federal appropriations which will necessitate a consistent program of uniformity which will justify the Federal outlay.

I know of nothing more shocking than the millions of public funds wasted in improved highways; wasted because there is no policy of maintenance. The neglect is not universal but it is very near it. There is nothing that Congress can do more effectively to end this shocking waste than condition all Federal aid on provisions for maintenance. Highways, no matter how generous the outlay for construction, can not be maintained without patrol and constant repairs. Such conditions insisted upon in the grant of Federal aid will safeguard the public which pays, and guard the Federal Government against political abuses, which tend to defeat the very purposes for which we authorize Federal expenditure."

Transportation conditions are a paramount consideration and should occupy the urgent thought of Federal, state and municipal bodies to effect a remedy. Railroad rehabilitation should be accomplished without delay and new roads should be constructed and old ones repaired so that food, merchandise, machinery and raw materials will move with despatch and flexibility from point of origin to destination. This will prove to be one of the greatest factors in securing the much heralded and most to be desired return to normalcy.

No local desire for preference or selfish gain should be permitted to impede progress in this direction.

HOUSING THE MASSES

The Metropolis of New York need have no fear of finding itself out of a job, and especially in the lines of work which itself provides. The supreme and unending business of the great city is that of growing, and it apparently was never farther from completion than now. To the thinking observer there is little that can be of greater interest than to watch the panting city forever trying to catch up with itself and to see it always hopelessly outdistanced.

There is little need of specifying in what it is most deficient. It must grow to live and live while it grows, and being alive in every part its growth must carry along the entire structure, so that practically it needs more of everything. It continually requires increased space for the carrying on of its manufacturing and commercial activities, and is acquiring the habit of seeking such spaces vertically when restricted horizontally. It requires greatly increased internal transportation facilities for the materials of daily consumption, for the mass of products it puts out, for its measureless waste and refuse, but especially for connecting the workers with their daily tasks at the one end and their places of rest and recuperation at the other. More than all, and more than ever before, it just now needs houses, or at least housing, in which the workers must spend more than a half of their living and breathing hours. This last is at present, and has been since the century began, in the most desperate and urgent need of satisfying and is apparently in the most hopeless state of accomplishment.

The trouble, after all, must mostly be left to correct itself, since no man is wise enough to suggest an effective plan or strong enough to enforce it. There are automatic safety devices or correcting devices in the big things as well as in the smaller ones which come into play when all else fails, and our ultimate reliance must be in something of that character in the present connection.

It is the habit of the worker in the big city to hire and not to own the place he lives in, and the providing and maintaining of such places of residence depends upon the assurance of pecuniary profit to the owner, and this assurance is apparently becoming more substantial and more stable from day to day. Rents are abnormally high and promising to remain at a high level. The costs of material and of labor are tending somewhat downward, and as a matter of fact the building of apartment houses—not to call them tenements any more—is becoming more or less active in the outlying boroughs of New York. In the Bronx, for instance, large structures are now being erected with a rush which will accommodate thousands of families, and doubtless others will follow them in increasing numbers.

Our interest in this matter has led us to note one little detail in connection with the erection of these large apartment houses, which has its bearing on the ultimate costs and the consequent burden to be carried. A very substantial item of the cost is in the excavation for the foundation. There are quantities of earth to be removed and also large masses of rock to be cut and carried away, in some cases the rock surface being above the street level. In all this work a single decade has brought a great change as to the means employed and the costs involved. Only ten years ago pickaxe and shovel would have dug the earth and horse drawn wagons would have taken it away. Then for the rock excavation there would have been a steam boiler on the street and one or two heavy tripod drills to be laboriously handled and operated and removed and replaced to accommodate the blasting, the resulting debris then removed by hand labor.

A typical up-to-date operation in precisely the same line of work has during the past month or two come under the observation of the present writer. The first intimation that anything was going on was in the arrival on the spot of a steam shovel and in an hour or two it was shoveling earth into gasoline driven, automatically dumping trucks, keeping a string of them busy for two or three days. Before its work was entirely completed a portable air compressor, gasoline driven, had made its appearance and at one corner of the lot two Jackhamers were soon rattling away with frequent blasting between. The compressor and the Jackhamers worked two eight hour shifts per day and their work was soon done. The building of the rough stone foundation walls was begun at once and the indications are that before these lines greet the reader the entire brick walls for the five-story walk-up will be completed. The saving of time and cost is evident without comment. R.

PIERCING THE SECRETS OF THE HIMALAYAN AIR

THE PRESENT attempt of a British exploring expedition to climb Mount Everest, the highest of many peaks reaching to tremendous altitudes in the Himalayas, and the world's loftiest and most mysterious mountain, is attracting the attention everywhere of engineers, geologists, physicists and other men of science, to say nothing of its firing the imagination of the lay mind. The explorers, from all accounts, have a tough job before them, because of the battle they must wage with the rarefied atmosphere and other known and unknown terrors.

Once arrived at the "Roof of the World,"

as the Tibetan plateau is not too fancifully designated, the explorers will start their real work at an altitude of 15,000 feet, greater than that of Pike's Peak or of the Continental Divide in the Rockies, or of Mount Blanc in the French Alps, which will give most folk some idea of the conditions to be faced. Many travelers find quite trying the mile altitude of Denver and not a few find Mexico City, about 25 per cent higher, exceedingly uncomfortable, as far as exertion is concerned. The height of Mount Everest has been variously measured by surveyors as being between 29,002 feet to 30,366 feet, and it is probably somewhere within this range, or roughly a matter of five and two-thirds miles.

The world's highest permanent human settlement is a Tibetan hamlet at an altitude of 16,500 feet, while there are Buddhist monasteries at elevations of 15,000 feet in the foothills of the Himalayas. A great area of Tibet, larger than that of the easternmost third of the United States, is for the most part above 12,000 feet in elevation, or more than twice the height of Denver, and has a thinly scattered population of 3,000,000. The natives of the region have short legs suited to the rough going of their mode of life, and have broad, deep chests, with extraordinary lung capacity. If these people are suddenly taken to sea level, it has been learned, they quickly succumb to the effects of air pressure, and are said to be literally drowned in the heavier air. The effect of a sudden transposition from a very high altitude to sea level is much like that suffered by submarine divers or workers in tunnel caissons under compressed air when they emerge into normal pressure too quickly.

The scientific phases of the Mount Everest expedition, therefore, that arouse the greatest scientific interest, are those that concern this subject of air pressure. It is a mooted academic question, we believe, how high up in the air a human being accustomed to sea-level atmosphere, for instance, would have to go before he would be physically incapacitated from the change in pressure on his body, which is of course adjusted to resist a normal pressure of fifteen pounds to the square inch. Very few persons have ever reached the height of Mount Everest either by balloon or airplane. The record-breaking flight of Major R. W. Schroeder to 33,113 feet on February 27, 1920, which was later described in these columns, was accomplished by means of a supercharger for the engine, with every protection for the airman and oxygen tanks to reinforce the air for breathing. It was, however, a terrific ordeal for the aviator, though he was at the extreme heights for only a matter of a few minutes.

Those who have made investigations into the subject, we read, have found that aviators in the European war collapsed or became unconscious at the height of Mount Everest, which they only momentarily touched. The annals of balloon ascensions of the last 50 years are filled with records of deaths due to insufficient oxygen supply.

The human body is known also to suffer exceedingly from the effects of the sun's rays when at great altitudes, which is due to the fact that the intensity of the rays nearly shut off by the moisture content of the lower airs, finds little to obstruct it at such heights as that of Everest. Also the character of the rays exerts a destructive effect on the human body when it is too long exposed to them. In the tropics, even near sea level, these rays often have unsuspected effect on newcomers not accustomed to them, and scientific care must be given to the choice and color of clothing worn. When the white men in the Everest exploring party get into really high altitudes it will prove an essential caution, say the authorities on the subject, that they keep their faces well covered with grease paint or lanolin. Inch-thick cork or pith helmets also must be constantly worn.

Meantime the feet must be protected against frostbite by shoes lined with fur and so made that no metal fastenings or nails shall come in contact with the lining and thus conduct heat away from the foot when walking on snow at below zero temperatures. At night the temperature on the upper levels of these mountains drops to from 20 to 60 degrees below zero Fahrenheit, so the explorer must repose in a fur-lined sleeping bag while enclosed in an inner bag of quilted eider-down. In daytime members of the party must wear two suits of heavy woolen underwear beneath wool and fur outergarments.

Under these adverse conditions the famous party of the Duke of the Abruzzi, which negotiated part of the way up these heights, found that a vertical climb of 200 feet was an entirely sufficient day's work! All these points will afford the uninitiated some idea of the difficulties and dangers attendant upon this scientific expedition. The higher the explorers climb the more will their strength and appetites wane. In the rarefied atmosphere one can hear the loud thumping of his own heart. Lifting a foot becomes a great effort and rapid movement is impossible.

Sudden avalanches and storms constitute two of the ever-present dangers that are encountered in exploration of the Himalayas. A tremendous and irresistible avalanche will sometimes descend in a valley and obliterate everything in its path. Strangely enough, persons have lost their lives half a mile away from the crashing rocks, ice and other debris, because of the very great changes wrought suddenly in air pressure. The great moving masses of material pack down the air in the valley so swiftly to a high pressure that the human frame cannot withstand it, the lungs and other organs being severely injured from the sudden impact of several atmospheres.

On the other hand low air pressure claims its victims, of course, among exploring mountaineers at such heights. The effects of low air pressure have been called "mountain sickness." At sea level the barometer registers 30 inches; more than five miles high, on Mount Everest, it would register nine inches.

If the adventurous British undertaking headed by Col. HOWARD BURY, which has just lately headed into the Tibetan fastness from India, succeeds in reaching the top of Mount Everest, they will have accomplished a greater feat, many explorers contend, than the winning of the North Pole. One thing the expedition can determine when it plants its barograph or altimeter at the final high point, is the exact height of the mountain. Many doubt that they will ever get more than half way to the summit, even under the best of conditions, but they will be able to get an accurate close-up measurement of the height, nevertheless, by surveyors' computations above the recorded barograph point. No member of the Indian Survey has been permitted by the Tibetans, hostile as they are to foreigners, to get nearer to the mountain than 87 miles.

Because of the scientific data it is hoped Colonel BURY's party will obtain, COMPRESSED AIR MAGAZINE, with other watchers in the world of science, will wait upon the ultimate results of so exciting a project with the greatest interest. Here's the best of luck to these hardy *voyageurs* in quest of fact in the upper air, and may their findings have highly significant values! F. J. T.

GOOD MANAGEMENT—MINUS THE "SCIENTIFIC"

Good management, equally with bad management, says *The Engineer*, London, has existed ever since there have been factories to be managed. It consists in regarding the workmen as fellow human beings rather than as complicated and unsatisfactory machines, and in adopting every labor-saving device or improved process of manufacture which can be justified on economic grounds. Good management is not made any better by being called "scientific management" and those who arrogate to themselves the epithet "scientific" must not claim the credit for having discovered the wisdom of providing for the workman the most appropriate equipment and conditions for performing his particular duties. Similarly the motion students have no right to presume that nobody heretofore has realized that manual operations can be well or badly performed. Every engineer will remember being instructed when an apprentice in the best way to hold a chisel or to use a file, and that he acquired his individual skill in handicraft by continued practice based on general instructions. All skill is a function of the individual, depending on the combined action of hand and brain, and it is more than questionable whether expertness can be transmitted from one man to another, except in a limited degree, or otherwise than by the methods which experience has developed. Training the muscles of the hand will not produce a Shakespeare or a Paderewski, and, similarly, it will not make a good mechanic. The brain which directs the muscles is the essential thing.

Favorable report on the Keyes bill creating a separate Bureau of Aeronautics in the Navy Department was voted recently by the Senate Naval Committee. Members said the bill would be placed before the Senate for adoption at an early date.

A House committee continued hearings recently on a similar bill, with Captain Moffett, Director of Naval Aviation, as the chief witness.

DEVELOPMENT OF THE HEINE BOILER IN AMERICA

A communication was received regarding a statement which appeared in the May issue of COMPRESSED AIR MAGAZINE referring to the death of John J. Main of Toronto, Ont. We reproduce this statement in the following together with some abstracts from our correspondent. Our original statement was as follows:

"John J. Main of Toronto, Ontario, president of the Canadian Incinerator Co., and a director of the Dominion Radiator Co., died recently at the age of 70. He was the inventor of the Heine boiler and was responsible for many important developments in connection with foundry work. He emigrated from the Island of Jersey to Canada when young, engaged himself as a boiler worker, and as a result of his invention of the Heine boiler made a connection with the Polson Iron Works of which he became vice-president and general manager. He retired some years ago but during the war served on the Imperial Munitions Board."

An exception to the foregoing is taken in the following:

"The statement that John J. Main of Toronto, Ontario, was the inventor of the Heine boiler is so absolutely without foundation of fact and also so entirely unjust to Col. E. D. Meier and his life achievement, that I feel it necessary to call your attention to the actual facts.

The original patent of the Heine boiler was taken out by Herman Heine of Berlin, Germany, the American rights of which were purchased by Col. E. D. Meier in 1883. Col. E. D. Meier then founded the Heine Safety Boiler Co., which was incorporated by him in 1884.

The initial patent or invention covering the principle of the Heine boiler was the work of Herman Heine. All others subsequent to that were gotten out either by Col. E. D. Meier or engineers associated with him.

Mr. John J. Main was connected with the Polson Iron Works of Toronto, Ontario, Canada, and became associated with Col. Meier in the development of the Heine boiler because an arrangement was made by which the Polson Iron Works, of which Mr. Main was an officer, acted as Canadian agents for the Heine Safety Boiler Co. Mr. Main had nothing whatever to do with the invention of the Heine boiler and his activities in connection with its development were confined to sales promotion work undertaken by the Polson Iron Works.

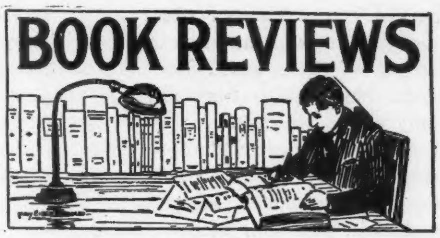
(Sgd.) JOHN HUNTER,
Chief Engineer Heine Safety Boiler.

WAR INSTRUMENTS DESTROYED BY PEACE TREATY

The Government Observatory in Saxony, the State Aeronautical Institute at Lindenberg, and the Geophysical Institute of Leipsic and Frankfort have asked the Allied Controlling Commission for permission to use certain range finders out of the military equipment, for scientific purposes, but according to the conditions of the peace treaty these instruments were considered military equipment and, consequently, had to be destroyed. After lengthy negotiations the Allied Controlling Commission has decided that the request of the above scientific institutions cannot be granted and that these valuable instruments must be destroyed. The same applies to a great number of field glasses of very high luminosity specially made for the use of air pilots during the war.

ZINC IS ZINC

Zinc seems to be unfortunate in its nomenclature. Gold is gold, silver is silver and so on, but at the mines zinc blende is called "jack," until recently slab zinc has been known only as spelter, and we say "galvanize" when we really mean "zincize," to cover with a coating of zinc.



HANDBOOK OF STANDARD DETAILS, by CHARLES H. HUGHES, author of *Handbook of Ship Calculations, Construction and Operation.* Illustrated and indexed; 312 pp.; Price, $6, net; New York and London, D. Appleton & Co.

THIS BOOK was compiled especially for engineers and draftsmen so that they might have, in convenient form, drawings, tables, and formulae of standard details for use in designing.

The data have been obtained from a variety of sources. Many of the tables have been furnished by the leading machine tool manufacturers in the United States and represent their current practice.

Besides being of use to engineers and draftsmen, students, purchasing agents and others, everyone interested in mechanical engineering will find the book of value.

The volume is essentially a compilation of the standard types, dimensions, sizes, weights, etc., of the materials and manufactured parts used in the construction of machinery and engineering structures.

No previous book has gathered together, as this one does, all the data on standard details. Some of the standards have been set by organizations of engineers and manufacturers, while others have been more or less arbitrarily set by leading manufacturers. The standards cover fastenings, power transmission, pipe, tubing and fittings, rope and chain fittings, structural details and a large number of miscellaneous parts. Material on standard engineering drawings, and a large number of tables of value to the engineer and designer are included. This book is invaluable for handy reference and forms a complete guide to the available parts and materials used by engineers and draftsmen.

FLYING GUIDE AND LOG BOOK, by BRUCE EYTINGE, Honorary Lieutenant, Royal Air Force-Pilot; Captain, Aerial Police Reserve, N. Y. C.; Member, Aero Club of America, N. Y. C., with a foreword by H. M. Hickane, Major, Air Service; Chief, Information Group, A. S.; Member, Aero Club of America, N. Y. C. Price $2.50, postpaid; 150 pp.; 38 illustrations; 1921 edition, enlarged and revised to date.

THIS BOOK contains valuable information for all those who are interested in, and desire to help in the development of commercial aviation.

The greatest factor, we are told in the foreword that is retarding the growth of commercial aeronautics in the United States today is the lack of established landing fields. These are absolutely essential to commercial aeronautics. Airplanes cannot land in every field so it becomes necessary to prepare fields suited for their landing and taking off. In addition to giving many helpful hints for aviators, the author has included a complete list of Federal, municipal and private landing fields throughout the country, their location, dimensions and the characteristic nature of surrounding buildings and landmarks.

U. S. War Department Orders, with reference to specifications for Municipal Landing Fields, and flying rules to be observed at all U. S. Flying Fields, add very materially to the value of this practical book.

Photographs of landing fields throughout the country, taken from airplanes, form an interesting feature.

Many helpful hints for those actively engaged in aviation are given, complete directions for "trouble shooting" in airplane engines being featured.

Aviators, air-plane mechanics, and anyone who is at all interested in, or helping to develop, commercial aviation, will find this indispensable.

One feature of this book will be found very desirable and is worth while noting and that is a ruled division of 24 pages for the purpose of keeping a record of the machine, motor and pilot's flying time.

FINANCIAL ENGINEERING, a text for consulting, managing and designing engineers and for students, by O. B. GOLDMAN. Illustrated with 54 charts; 271 pp.; Price, $3.50 net. New York: John Wiley & Sons.

THIS BOOK furnishes the rules by which the engineer may determine the value, economically, of the different types and installations of machinery. It gives the engineer a basis for rate-fixing, by translating units of time and power into dollars. With this book the engineer can also determine the financial efficiency of a system, or any of its parts, when the mechanical efficiency is known. It will be found useful in organizing new plants or systems, where economy is effected by choosing units of proper size. The book has been written primarily for the practicing engineer. All mathematical deductions are marked out in detail, leaving no gaps for the reader to bridge. A prominent consulting engineer who examined the manuscript said, "That is the sort of material the colleges do not teach, and that a young engineer now has to acquire after he gets out into business—and then he pays 'drug store' prices for it."

The table of contents is divided as follows: Cost segregation, fundamental financial calculations, basic cost, vestances, determination of size of system for best financial efficiency, determination of type and size of units.

Every engineer in a responsible position has felt the need of solving engineering problems in terms of money which necessarily means he must supplement his technical education with a knowledge of finance in order to make a complete and harmonious whole. To be able to determine by a definite scientific method the comparative value of all things he must use and the value of investments in general is a decidedly useful acquisition.

This volume aims to place the engineer in a position wherein he will be able to meet the financial phases of his work and come to an intelligent conclusion, and with the aid of an instructor the student also is able to master all mathematical problems, as examples are fully worked out to illustrate the practical application.

A "products catalog" has recently been issued by the Ingersoll Rand Co. containing a general description of the numerous products manufactured by the company. It will prove a useful addition to any engineer's or company's library as a means of ready reference for many problems which occur in the course of usual operations. We refer particularly to the engineering section which contains data for the solution of every day pneumatic problems and which has been presented in such detail that it very likely will be found sufficient to determine exact requirements for new installations. The catalog is well indexed, contains 196 pp. and shows numerous charts, tables and illustrations. Anyone using or who may possibly use compressed air in its various mechanical applications should avail themselves of the opportunity to obtain a copy of this catalog.

The B. F. Sturtevant Company, Boston, Mass., has issued an engineering bulletin, No. 261, containing information about pneumatic collecting and conveying systems for dust removal and other purposes, as manufactured by this company. The illustrations show the various types of fans made by the concern, a variety of types and plans of dust removal installations, piping, hoods and power arrangements. The text explains in detail the points to be considered in dust collecting as well as including a number of tables on pressures, friction losses, velocities and sizes, capacities and weights of exhausters and piping.

A new instrument of precision has recently come to light combining all the advantages of the stop watch and the time study watch and has in addition a split second feature. The agency for time and motion study watches and other instruments of precision formerly held by M. J. Silberberg has been taken over by Stein & Ellbogen Company, 31 North State Street, Chicago, who will have exclusive control of their distribution. The split second time study watch has a double hand and in addition to other features permits the taking of two totally different operations at the same time, or the taking of observations on two closely related operations, each different from the other. The watch has in addition the production dial feature used on the time study watch which saves the mental or pencil computation after the observation has been taken and gives a mechanical testimony that cannot be questioned, showing the amount of production per hour after one operation has been performed.

We acknowledge receipt of the 1920-21 Catalogue of the School of Mines and Metallurgy of the University of Missouri, Rolla, Mo. This is the fiftieth edition and gives a complete description of the activities of the university in the education of young engineers. The curricula of engineering courses are tabulated including mining, metallurgy, chemistry, civil engineering, mechanical and electrical engineering, etc.

MEASURING VENTILATION IN COAL MINES

Professor J. T. McGregor Morris, in a paper read before the British Association, describes a method for measuring the ventilation in coal mines, which depends on the change which takes place in a length of thin wire over which the air is allowed to pass and which is heated by an electric current of constant strength.

Under the heating action of the current, the wire attains a constant temperature in a few seconds. Heat is then being absorbed from it by the air passing over it, and the higher the velocity of air, the smaller will be the rise in temperature. This fact permits of the determination of the rate at which the air is passing. When a wire changes in temperature, both its length and electrical resistance change. In many ways it would be simpler to take advantage of the change in length, but this effect is so minute that it is considered better to utilize the change in electrical resistance. To obtain the same effect mechanically would entail double the length of wire when raised to 400 deg. or 500 deg. F.

In the portable anemometer designed by the author, a nickel wire is employed having an electrical resistivity temperature coefficient of 0.474 per cent. per deg. C., calculated on 20 deg. C. The box containing the apparatus is 10 in. x 6½ in x 7 in. deep, and the weight complete is 13 lb. A reading is given directly in miles per hour, and the precision obtainable is said to be higher than with existing apparatus.

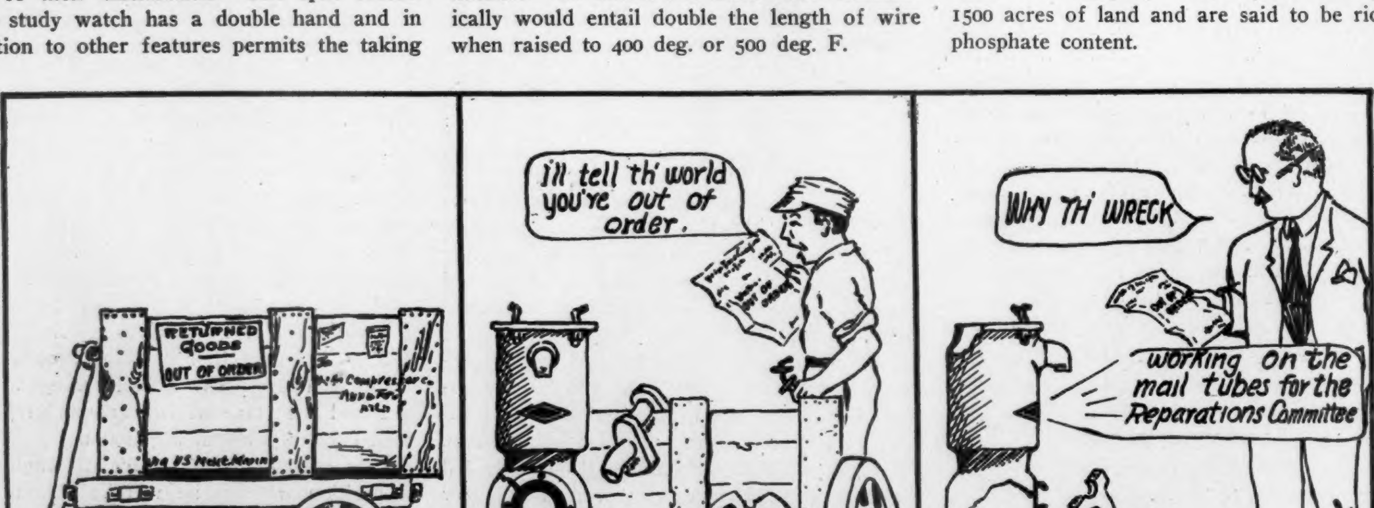
NUMEROUS FATAL DUST EXPLOSIONS

The Bureau of Chemistry of the U. S. Department of Agriculture is conducting investigations into the causes and the means of prevention of dust explosions and resulting fires in grain mills, grain elevators and other grain handling plants. A partial record of such casualties suggests the magnitude of the danger.

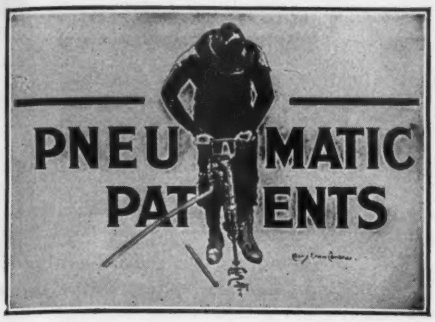
A survey covering a period of two years shows that dust explosions have occurred in the United States and Canada during that time, resulting in the death of nearly 100 persons, injury to a large number, and property damage in excess of $10,000,000. Four occurred in grain elevators, two in flour mills, one in a feed mill, and one in a starch factory, this last causing 43 deaths and over $3,000,000 property damage. In three grain elevator explosions, fourteen lives were lost in one, ten in another, and six in the third, all of them doing extensive damage. In an explosion of aluminum dust, six girls lost their lives and as many more were injured. An explosion of hardrubber dust resulted in the death of eight workmen.

A bill introduced in the Senate provides appropriation of $100,000 to conduct further investigation of dust explosions in industrial plants.

The phosphate beds located east of Big Pine, Calif., have been purchased by the Big Pine Fertilizer Company. These beds comprise 1500 acres of land and are said to be rich in phosphate content.



THE REWARD OF DIPLOMATIC SERVICE



MAY 3

1,376,467. COMPRESSOR SYSTEM. Karl A. Simmon, Edgewood Park, Pa.

12. In a compressor system for a vehicle, the combination with a motor-driven compressor, and a compressor driven by the momentum of the vehicle, of means for selectively operating said compressors in accordance with the fluid pressure in the compressor system, means for preventing the simultaneous operation of the two compressors, and means for insuring the operation of the compressors in a given sequence under normal operating conditions.

1,376,545. PNEUMATIC DRILL. Corwill Jackson, Kalamazoo, Mich.

1,376,573. AIR-BRAKE. Henri Pieper, Liege, Belgium.

1,376,804. PULSATOR. Ira G. Fosler, Chicago, Ill.

1,376,985. METHOD OF AND APPARATUS FOR DRYING COMPRESSED GASES. Walter Wilkinson, Jersey City, N. J.

1. A method of separating moisture from compressed gases preliminary to the storage of the gas in shipping receptacles which comprises, causing the gas to travel in indirect contact and countercurrent with preceding portions thereof whereby the compressed gas is cooled to a temperature insuring separation of the major portion of the moisture carried by the gas, withdrawing the separated moisture while the gas is at the low temperature, conveying in indirect contact with the compressed gas additional cooling medium to compensate for heat derived from the surrounding atmosphere and from condensation of the moisture, and conveying the compressed dehydrated gas to the shipping receptacle.

1,376,991. BLOWPIPE. George H. Zouck, Orange, N. J., and George L. Walker, New York, N. Y.

1,377,009. PROCESS OF AND APPARATUS FOR APPLYING LIQUID TO SURFACES. Clement E. Dunn, Burlingame, Calif.

1,377,136. PNEUMATIC MECHANISM FOR CONVEYING AND STACKING FOOD PRODUCTS. Edward E. Lawrence, Jamaica, and Kenneth D. Loose, New York, N. Y.

MAY 10

1,377,244. PORTABLE MILKING-MACHINE. Alfred Ekern, Minneapolis, and Rudolf A. Tanner, St. Paul, Minn.

1,377,277. VACUUM FEED APPARATUS. Frank V. Risinger, Youngstown, Ohio.

1,377,372. MACHINE FOR CASTING METALS. Ralph Willmett Thompson, Leith, Scotland.

1,377,400. BLOWER. Frans H. C. Coppus, Worcester, Mass.

1,377,403. POWER - OPERATED AIR-PUMP FOR AUTOMOBILES. Ernest David, Maywood, Ill.

1,377,479. LIQUID-FUEL BURNER. Charles C. Hansen, Easton, Pa.

1,377,546-7. MILKING MACHINE. John C. Beem, Sawtelle, Calif.

1,377,520. SIGNAL. Lonnie Thomas Penny, Raleigh, N. C.

1,377,563. TIRE-INFLATING PUMP. Thomas Morris Davies, Llanelly, Wales.

1,377,583. FLUID-COMPRESSOR. Samuel H. Human, Chicago, Ill.

1,377,594. AIR-HUMIDIFIER. Adolph W. Lissauer, New York, N. Y.

1,377,622. SOOT-BLOWING DEVICE. James Kemnal, Chislehurst, and John Henry, London, England.

1,377,654. SPRAYING-MACHINE. Henry C. Baumgardner, Ann Arbor, Mich.

1,377,687. OIL-BURNING TORCH. Charles B. Jahnke, Beloit, Wis.

1,377,693. REFRIGERATING COMPRESSOR. George F. Knox, Milwaukee, Wis.

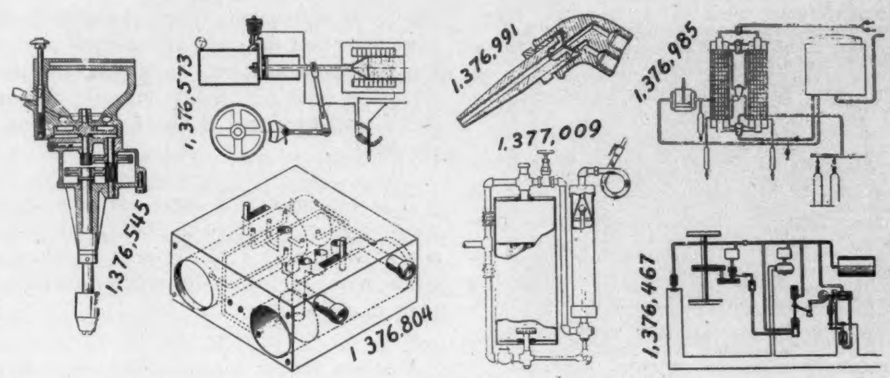
1,377,745. PNEUMATIC MOTOR. Joseph F. Buhr, Detroit, Mich.

1,377,752. AIR-PUMP. William D. Coil, Madisonville, Ky.

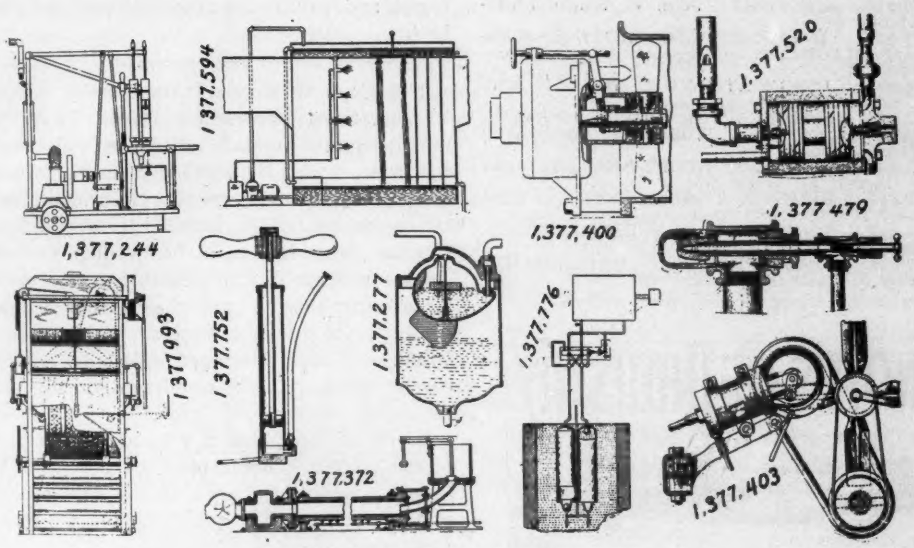
1,377,776. PUMPING APPARATUS. William E. Janney, Toronto, Ontario, Canada, and Harry E. Fiscel and Jesse L. Miller, Pittsburgh, Pa.

1,377,922-3. AIR - STORAGE - TANK LIQUID-DISPENSING DEVICE. Emit M. Posa, Burleson, Tex.

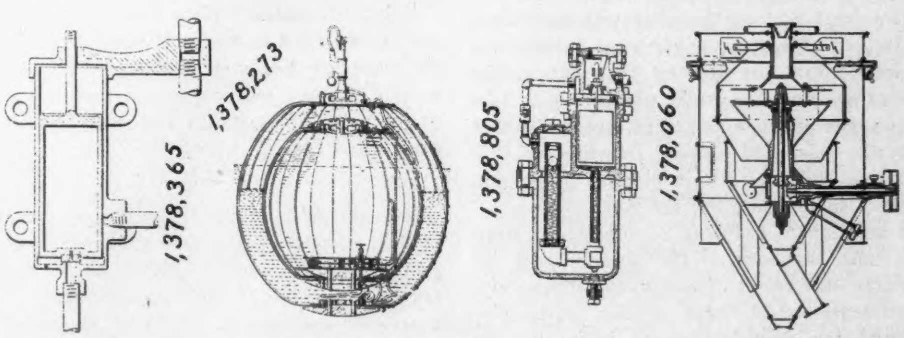
1,377,981. COMPRESSOR - CONTROLLING



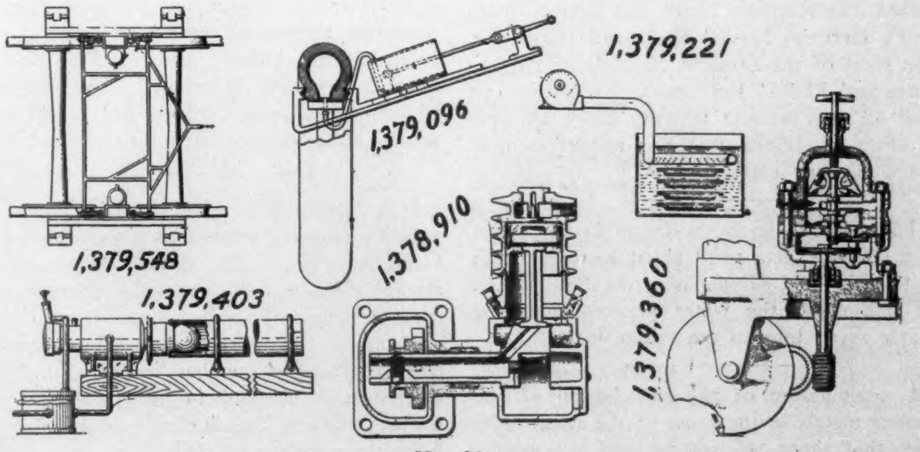
May 3



May 10



May 17



May 24

MECHANISM. Fred D. Holdsworth, Claremont, N. H.
1,377,993. SAND-BLAST MACHINE. Elmer A. Rich, Jr., Chicago, Ill.
1,377,998. SUCTION OR BLOWING APPARATUS. Ira H. Spencer, West Hartford, Conn.

MAY 17

1,387,028. COMPRESSOR - OVERLOAD REGULATOR. Thomas J. Hart, Corning, N. Y.
1,378,060. AIR-SEPARATOR. Thomas J. Sturtevant, Wellesley, Mass.
1,378,273. LIFE-SAVING APPARATUS. Giovanni Picco, New York, N. Y.
1,378,365. AIR-BRAKE SYSTEM. Donald R. MacBain, Cleveland, Ohio.
1,378,395. AIR-BRAKE SWITCH. Ferdinand Bechoff and Maurice M. Samuels, New York, N. Y.
1,378,717. AIR SATURATING TOWER. Harold Neilsen, Middlesex, and Frederick Deacon Marshall, Westminster, London, England.
1,378,805. DRY-PIPE ACCELERATOR. Arthur C. Rowley, Philadelphia, Pa.

MAY 24

1,378,910. AIH-PUMP. John W. Smith, Philadelphia, Pa.
1,378,922. INTERMITTENT-VACUUM MASSAGE-MACHINE. George A. Ward, Chicago, Ill.
1,379,096. PNEUMATIC-TIRE PUMP. John C. Gilbert, Grafton, Mass.
1,379,221. PROCESS FOR PURIFYING AIR. Henry P. Scott and William G. Bond, Wilmington, Del.
1,379,248. ROTARY AIR-COMPRESSOR. John O. Carrey, St. Louis, Mo.
1,379,360. BLOWPIPE APPARATUS. Raymond B. Pickering, Alameda, Calif.
1,379,403. PNEUMATIC BALL-PROJECTOR. Charles R. Green, Indianapolis, Ind.
1,379,548. FLUID-PRESSURE RAIL-BRAKE. Peter J. Gaillard, Chicago, Ill.

Another reduction in price of Hercules Explosives and Blasting Supplies was announced on June 1. Hercules 40 per cent gelatin was reduced $35.00 per ton on that date. The present price of this grade, which may be taken as a fair example, is 25 per cent below that of 1918. It should also be remembered that explosives did not raise in price in proportion to other supplies, during the war.

In addition to reducing its prices, the company also announced the development of formulae—the result of exhaustive studies and experiments—which have enabled it to discontinue the manufacture of high freezing dynamites without sacrificing any desirable feature which those grades possessed. This means that Hercules Extra and Gelatin dynamites, Hercules Special No. 1 and Hercomite, and most of the Straight Nitroglycerin dynamites and Red H Permissible Explosives can now be used without thawing under all temperature conditions that are encountered in practically any blasting work.

The greatest depth yet found in any ocean is 32,088 feet, at a point about 40 miles north of the island of Mindanas in the Phillippines. At this depth the water pressure must be nearly seven tons to the square inch.

A computation of the distribution of the various metals in the crust of the earth indicates that about 1½ per cent. of the weight consists of iron and about 5 per cent. aluminum. Of the various chemical elements, oxygen enters into the crust of the earth, into water, and the atmosphere to a weight of more than the combined weight of all other elements, and hydrogen is about 16 per cent. of the total.

It is estimated that there are now 23,000,000 horses in the United States, and 19,000,000 of them would be required to equal the power now supplied by the central electric stations of the country.

A steam shovel is rehandling coal on the island of Spitzbergen, well within the Arctic circle. The bottom layers of the coal are frozen and it cannot be taken out with the grab bucket.

The C. & G. Cooper Company of Mount Vernon, Ohio, have added Dallas, Texas, to their chain of branch offices at Suite 626, Great Southern Life building in Dallas, where those interested can procure information on all equipment. This includes Corliss Steam Engines, large horizontal heavy duty gas engines for either direct connected generator or compressor service, and the smaller single-acting direct driven compressor units. These latter have been developed especially for the severe service in the southwestern oil and gas fields.

Mr. H. P. Simpkinson, who has been transferred from the home office of the C. & G. Cooper Co., is in charge of the new branch at Dallas, Tex. The plans include a service department.

Figures compiled by the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, show that in the month of April machinery and machine tools to the value of $2,055,422 were exported from the United States.

Because African producers cannot dispose of their stones readily, they are curtailing the production of diamonds. Of the 11,000 people normally employed in the diamond cutting industry in Amsterdam, Holland, almost 8,000 are out of work.

For reasons of economy and difficulties of operation all the air mail routes, except the transcontinental line from New York to San Francisco, will be abandoned. The St. Paul-Chicago, St. Louis-Chicago and other short routes already have been discontinued.

It is proposed to electrify all French canals which carry more than 2,000,000 tons of traffic per annum. Sections of various canals already electrified show that this program will mean a saving of about 1,500,000 tons of coal per annum. In 1920 French canals handled 96,518,681 tons of merchandise, as against 52,428,400 tons handled in 1919. During the war 645 miles of French canals were destroyed. Since the armistice 632 miles have been wholly reconstructed.

Mr. James Prentice Sneddon, director of manufacturing activities for Babcock & Wilcox Co., Bayonne, N. J., died recently at Johns Hopkins hospital, Baltimore, following two operations. Mr. Sneddon was also vice-president of the Pittsburgh Seamless Tube Co., Beaver Falls, Pa. He was 58 years of age.

Mr. Milan R. Bump of New York, chief engineer for Henry L. Doherty & Co., has been elected president of the National Electric Light Association, which held its annual meeting in Chicago recently.

Mr. F. M. Feiker, vice president and chairman of the editorial board of the McGraw-Hill Company, has been appointed personal assistant to Herbert Hoover, Secretary of Commerce, with the title of assistant to the secretary.

Mr. W. S. Hanley, chief engineer of the New Orleans Great Northern, and stationed at Bogalusa, La., has been appointed chief engineer of the St. Louis Southwestern, with headquarters at Tyler, Tex.

Mr. Quartus Almon Gillmore, superintendent of the ore docks of the American Steel & Wire Co. at Cleveland, died at his home recently. Mr. Gillmore was born at Lorain, Ohio, and was 60 years of age at his death. After graduating he started in the dredging business with his father and was later employed by the city of Lorain.

Report of the Bureau of Mines

The Tenth Annual Report of the Bureau of Mines of the U. S. Department of the Interior, for the fiscal year ending June 30, 1920, has been issued. It is difficult to give it an adequate notice within the space which can be spared. The Bureau is doing a wonderful amount of honest, thorough work of untold practical value, and its work increases continually. This is suggested in the opening paragraph of the report:

"During the year the completion and dedication of the magnificent Pittsburgh station and central laboratories of the Bureau of Mines marks an epoch in its growth. For the first time the Bureau of Mines has a suitable home and central headquarters for field and investigative work, and for this reason especially the bureau should be able to begin a period of even greater usefulness to the mining and metallurgical industries."

The Bureau is apparently quite well satisfied with itself, as it has good reason to be. The report is a concise enumeration of the detailed work actually done, and without a wasted word occupies about 150 pages, which we find it impossible to make abstracts from or condense.

COOLING, HEATING AND VENTILATING SYSTEM

EVER SINCE large auditoriums have been built the question of heating, ventilating and cooling such spaces has been an acute problem, appreciated only by the few heating and ventilating engineers specializing in this class of work. To the "man on the street" an auditorium, a church or a theatre is either too cold, too warm or smells badly. Perhaps he leaves with a feeling of heaviness or a headache which he blames on eyestrain or, in fact, anything but bad ventilation. If none of these conditions apply, he simply doesn't notice that he was comfortable—the matter never occurs to him. Yet, in the latter case, the auditorium was properly heated and ventilated.

About ten years ago, this matter was seriously considered by engineers with a view towards studying these problems and supplying the requirements of a system which would do away with all such defective ventilation.

The standard system today utilizes large fan units constructed to handle enormous volumes of air at a very low rate of power consumption. This air is propelled through the auditorium in large volumes at low velocity, and insures for each person in the room, an abundant supply of clean, fresh air.

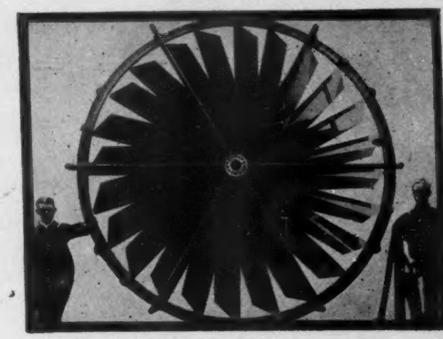
During the hot summer months, this tremendous volume of air produces a distinct breeze throughout the auditorium and its cooling effect is decidedly noticeable.

In the cold weather, the volume of air is reduced to the minimum required for perfect ventilation. This air is then passed over heating coils and treated in the same manner as for the cooling system. With a system at present being marketed there is no necessity for the use of direct radiators and in addition all expensive excavating and duct work are eliminated. In many buildings it has been found that this system, namely the "Typhoon," can be installed for the same price as a direct heating system.

The general features of the system are shown in the illustrations.

The fan is built in sizes from two to twelve feet. It is substantially constructed to the smallest detail and is built primarily for service of the most exacting kind. Its square angle iron framework readily adapts itself to most forms of construction, but, when necessary, a round frame can be furnished and the fan set in a brick wall.

The cast iron ring supporting the spiders is conical in shape and the blades are cut at an angle to fit closely to its inner surface. A great deal of the efficiency of the fan is due to this characteristic, as the side slip of the air from the blades is deflected by the slope of the ring so as to follow the natural flow of all the air passing through the fan. Each blade is braced and strengthened by means of a reinforcing piece closely riveted and before shipment each fan is completely assembled and accurately balanced.

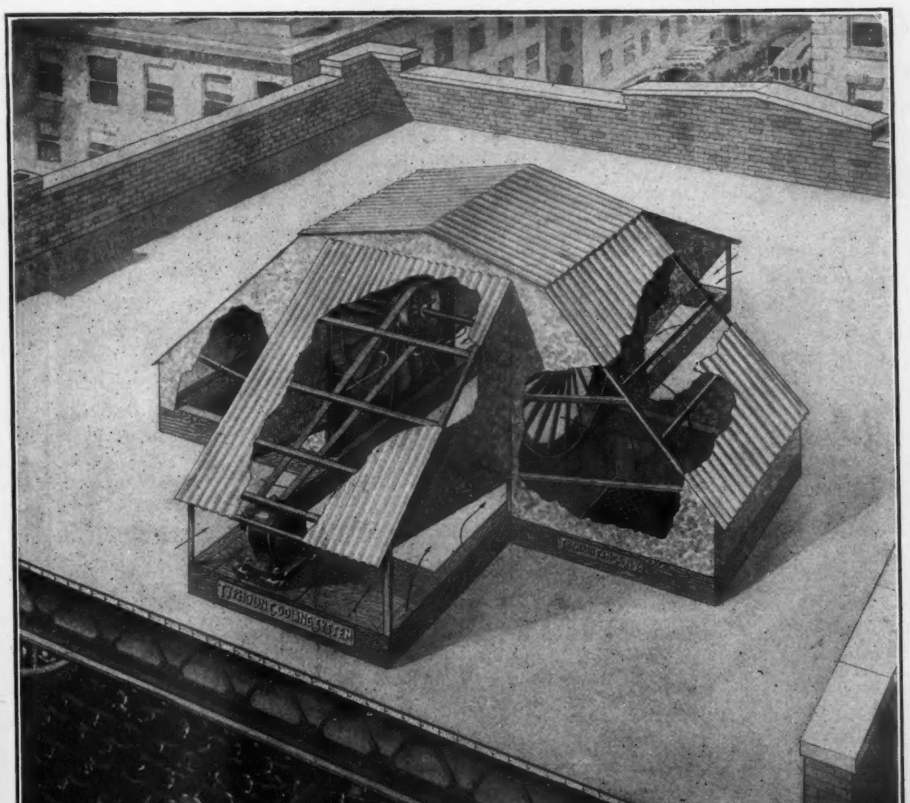


Giant typhoon—12 ft. in diameter.

Another important feature is its bearings. All sizes are supplied with self-aligning ball bearing contained in dust-proof grease cases. This bearing has been used with satisfaction and, when set in a grease case, the bearing may be run for many months without any attention whatsoever.

The large center disc prevents back lash of air through the center of the fan and the large number of blades gives an adequate volume of air.

In conjunction with the system, there may also be installed a system of temperature control which will accurately maintain any temperature desired. This control is maintained by means of a thermostat set in the room and connected to the heating medium with small piping containing compressed air. The compressed air when released uses this energy to close the steam valves or to operate dampers. A small electrically driven air compressor is also used and automatically maintains a pressure of about fifteen pounds, on all the air pipe.



Typhoon roof installation showing angle iron roof house with sheet metal finish.

AETNA EXPLOSIVES TAKEN OVER BY HERCULES CO.

Rumors of the proposed purchase of the Aetna Explosives Company, Inc., by the Hercules Powder Company received definite confirmation recently when the Aetna stockholders sanctioned the sale of its properties, assets, and business. This marked the culmination of a transaction that has interested financial and business circles for the past two years.

Although it has been understood practically since the close of the war that negotiations were under way between these two manufacturers, it was not until the petition of the Hercules Company for permission to purchase the Aetna Company had been acted on favorably by the Circuit Court of Appeals, that the proposition assumed any real definiteness. By this purchase the Hercules Company acquires high explosives, or dynamite, plants near Birmingham, Ala., Emporium, Pa., Sinnamahoning, Pa., Ishpeming, Mich., and Fayville, Ill., two black blasting powder plants, one at Goes Station, Ohio, and the other near Birmingham, Ala., a plant for the manufacture of blasting caps and electric blasting caps at Port Ewen, N. Y., and a plant for the manufacture of fulminate of mercury, for use in blasting caps, at Prescott, Ontario, Canada.

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